# The Electrical World.

VOL. XXV. NEW YORK, MAY 4, 1895. No. 18.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY, Limited,

253 Broadway, New York.

Established 1874. Incorporated 1889.

*Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.*

New England Office, 620 Atlantic Ave., Boston.

Western Office, 936 Monadnock Block, Chicago.

Philadelphia Office, 927 Chestnut Street.

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THE ELECTRICAL WORLD,

253 Broadway, New York.

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ROPE DRIVING.

In this issue we commence the publication of the concluding sections of Prof. Flather's valuable serial on rope driving. Owing to the long interval between the present and preceding sections, a synopis of these latter is given in order that the reader may intelligently follow the remaining portion. The subject of rope driving is one to which much attention has been given in Europe, but this is the first time it has been adequately treated by an American writer. In many cases the use of ropes over belts has an advantage, and the thorough manner in which Prof. Flather brings out all of the points connected with the subject will enable the engineer to easily determine if in a specific case it will be best to adopt that method of driving.

ELECTRIC RAILWAYS AND STEAM TRACTION.

The opening of the Chicago Metropolitan Elevated Railway was an event of unusual importance from an electrical standpoint, as electricity is here given the first opportunity on an extensive scale in this country to demonstrate its superiority over steam traction. The result of the first year's operation will be looked forward to with the greatest of interest, as a favorable outcome will undoubtedly cause steam power to be displaced by electricity on the New York elevated roads. The trial may indeed be considered one between electric and steam traction in general, for here direct comparison as to these two rivals may be made for the first time on a sufficiently extensive scale. Railroads are notoriously conservative, but if it can be shown, as we believe will be in this case, that the electric motor offers economic advantages over the steam locomotive, the comparison will be so obvious as to have the necessary force to disarm prejudice in favor of the latter. Whether it will ever pay to run trunk lines of railroads by electricity is a question as yet far in the future, but there can be no doubt at the present time as to the financial practicability of electric traction for moderate distances, or to its applicability on many lines now using steam. The recent decision of the New York Central Road to run trolley cars on its steam line between Buffalo and Niagara shows that this fact is beginning to be recognized. With the data that will be derived from the comparison between cost of operation on the Chicago and New York elevated lines, and the result of even more direct experience on the Buffalo-Niagara line, the advocate of electric traction will soon be in possession of facts that will be more efficacious than volumes of à priori considerations, and which will, we believe, have a great influence on the extension of the use of electricity for traction purposes.

A CONTROVERSY ON SUBWAY EXPLOSIONS.

Two of our English contemporaries have been having a battle royal as to the cause of explosions in conduits, and though the position of one has been sustained in part by the report of a committee appointed by the Royal Society and the Institution of Electrical Engineers, the other returns to the fray. It appears that one of the journals ascribed the explosions to the ignition of an explosive mixture of air and illuminating gas from the action of water on metallic sodium, and ascribed the existence of the sodium to electrolytic decomposition of the glazing of porcelain insulators. The report of the committee is in favor of this theory, except that it considers the ignition agent to be metallic sodium or potassium formed by the electrolytic action of leakage currents on saline deposits from the soil on the insulator supports or in the neighborhood of these supports. The recommendations of the committee are that the insulating surface between the conductor and insulator bearer should be larger, and that the bearers should not be made of wood. We are accustomed on this side of the water to consider our European brethren as holding all authority in awe, but the followin remarks on the report above referred to show that one of them has been emancipated, at least with regard to scientific authority :

"Disappointment is but a mild expression wherewith to connote the "state of our feelings in particular, and doubtless of the electrical "industry in general, upon reading the report of the committee "that was constituted to confer with the electrical adviser to the "Board of Trade with regard to the explosions in St. Pancras. The "formidable array of signatories to this report suggests the propriety "of making any criticism which we might be disposed to offer with, "as it were, bated breath. The spirit of that old statute of Richard "II. concerning what was wont to be called *scandalum magnàtum* "still survives, and one must needs refrain from disburdening the "soul too freely. We will mince matters, then, and simply observe "that we are grievously disappointed. * * * What do we find? "A single sheet of printed matter, and that a very small one, one "side being occupied by the 'report,' and the other by the 'evi- "dence.' The terms are doubtless used euphemistically: we will "use them out of courtesy, though it is in our minds to designate "this production as a mere *tabula rasa.* What wisdom lies in the "ancient classics! How truly the effusions of the worthy Horace "may be applied to a thing of to-day! *Parturiunt montes, nascetur "ridiculus mus.*"

ELECTRICAL DIMENSIONS AND NAMES.

In another column will be found an interesting article by Prof. Fessenden in which a number of imperfections in our present system of dimensions and names for electrical units are pointed out. That force, for example, should have different dimensions in the mechanical, electrostatic and electromagnetic systems of units, and that electromotive force is not a force at all in the proper sense of the word, are disparities in glaring contradiction to the much boasted scientific character of electrical units and terminology. While the points referred to have little or no direct effect aside from questions of theory or higher science, yet their indirect effect is of importance through the difficulty the inconsistencies offer to students in the understanding of principles, and their tendency to cause him to consider the entire system dealing with units as artificial and lacking a logical physical basis. Prof. Fessenden also refers to the usefulness of the terminations—*age*,—*ance*, and—*ivity*, though the general adoption of the former seems to be much less desirable than that of the latter. Resistivity for specific resistance is already passing largely into use, and the same is true of the term reluctivity, while permeability was established from the beginning. The remarks in regard to inductance are in line with the arguments offered for the application of that word to $L\omega$ instead of to $L$, but as its use in the latter sense has already become extensive, it would now be difficult to displace it by the proposed term, inductivity. There is yet time, however, to clear up the inconsistencies which exist in regard to dimensions and nomenclature if the matter were placed with an authoritative body like the Committee of the British Association which devised our present system of electrical units, as its recommendations would carry the great weight necessary. As the English are most jealous in regard to measures not originating with themselves, it would for that reason be desirable for the body to be of that nationality, and if it numbered among its members, as it probably would, such scientists as Kelvin, Rayleigh, J. J. Thomson and several others that could be mentioned, their verdict would probably be received in a liberal spirit in other countries, while the work would in the end be carried to a more logical conclusion than if performed by an international body hampered by national jealousies. As it is, however, the number of inconsistencies are relatively small in nomenclature, notwithstanding the independent nature of the growth of the large list, and the several additions recently suggested, like *admittance* and *susceptance*, are logical in their formation. It may here be remarked that the large additions to electrical nomenclature recently adopted, or suggested for adoption, are not evidence of a craze in word-coining, but are the natural result of a need following from the rapid development of alternating currents. Alternating current phenomena introduce a host of new ideas, to the more important of which it is but natural to assign specific names. In most cases the criticism directed at this increase is born of ignorance, those indulging in it not appreciating the desirability of the additions made, through a lack of knowledge of the necessities arising from the modern developments of electrical science. It is true that the class of savants look askance at the tendency toward the extension of electrical nomenclature, but this is because their habits of abstract thought do not require the assistance of concrete names in order to render ideas more definite.

## The Invention of the Carbon Telephone.

In a recent address Prof. Hughes renews his claims for the invention of the carbon telephone. Having experimented with the Reis telephone in 1865, the report of Bell's invention in 1876 caused him to again turn his attention to the subject, and he finally discovered the principle of the microphonic contact. All of the results of the lengthy investigation were given, he says, in a paper read before the Royal Society in May, 1878. Mr. Edison was, during the same months, engaged upon a similar research, that is, endeavoring to adapt Prof. Reis's method of transmission by a diaphragm and separate battery, and as a result, patented his carbon telephone. Prof. Hughes contends that the true principle involved in the Edison telephone is that of his microphonic contact, and that its action does not depend upon a varying resistance obtained by variable pressure of the diaphragm, as claimed by Edison. Besides, the principle of varying the resistance of carbon by pressure was not Edison's discovery, as it was well known for many years previous through Du Moncel's publication and its application by Clerac in his carbon resistance tube.

Prof. Hughes concludes as follows: "Unfortunately, Mr. Edison and myself had a painful discussion as to priority of invention, in which we have both sustained our individual views up to the present time. Mr. Edison's views have been sustained by all the companies owning his patent; mine have been sustained by nearly the whole scientific world. The companies, however, whose interest it was to sustain and possess for themselves an entire monopoly, have spared neither wealth nor power to obtain this coveted monopoly, and by the means of the ablest legal counsel and expert witnesses they obtained a legal decision giving them the sole right to the use of a diaphragm pressing upon a variable resistance, notwithstanding that the diaphragm was the discovery of Prof. Reis and microphonic contact by myself."

## An Ineffective Patent Decision.

The United States Circuit Court at Chicago recently entered decrees in several suits of the Western Electric Company against J. H. Bunnell & Company for infringement of certain patents on magneto call-bells. Among these were patents on switches automatically cutting in and out the magneto bell, on the longitudinal movement of the magneto shaft for switching, on the use of springs on the hinges of the magneto case lid for securing better contact, on the use of a polarized magneto armature, and on several mechanical details. The suits were not defended, and as in addition the decrees were entered by consent, the adjudication has effect only as concerns the specific defendant, and does not alter the situation previously existing with respect to others.

## ! ?

In a paper read at the recent annual meeting of the Ohio Gas Light Association, the author remarked that "if we are to believe the electric light man (*sic*)" there is an advantage in a light in which "a smaller amount of heat and obnoxious products of combustion are thrown off." This ludicrous attempt to say something stinging against a successful rival would not have attracted much attention, coming as it does from a gas man, but a few lines farther on he says,—and he must have underscored it in his manuscript, as it is in italics in the printed report—"being a gas man I am necessarily honest"; but we will do him the justice to suppose that he meant to be sarcastic in this.

## Another Discovery.

The Buffalo *Express* reports that Nikola Tesla had lately made further improvements in his method of transmitting electricity by fluid, and has declared that he is now more certain than ever that the current can be sent from Niagara Falls to New Orleans and Chicago, and delivered there at less than it would cost to generate power on the spot by steam. The fluid he uses in the tubes, it is stated, costs scarcely more than water, and loses so little electricity in transit that the cost of transmission is little more than the cost of putting up the poles and tubes.

## Professor Jules Francois Joubert.

BY ANDRÉ BLONDEL.

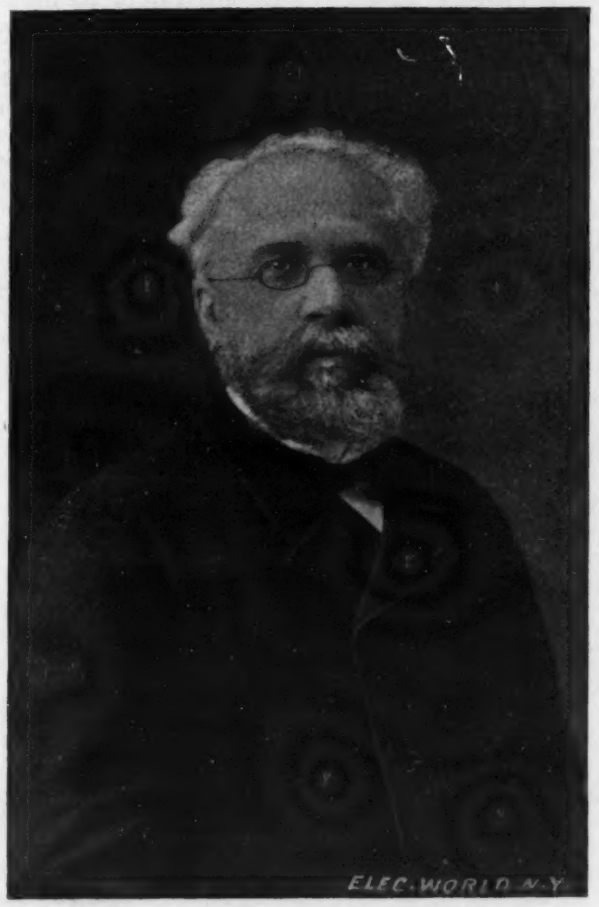
The electrical era dates, properly speaking, only from the Paris Electrical Exposition of 1881, and the most of those who had made discoveries in electricity at that epoch, and were the pioneers in its development, became electricians by chance, having previously applied their energies to entirely different occupations.

Professor Joubert, whose name should be universally known to the present generation of electricians, was himself an outsider, and, like the great Helmholtz, it was to the natural sciences and particularly to biology, to which he had devoted the first part of his career, that he owed the training which led to the discovery in electricity destined to make him most celebrated.

Born at Tours, France, in 1834, Professor Joubert began his studies at that place, and in 1857, entered the Ecole Normale Superieure at Paris. This school, the number of whose students is very small, those admitted to the scientific sections not exceeding 20 annually, is the nursery from which the State obtains its most brilliant professors for the lycées and universities; at that epoch it was, in fact, the only door open through which to enter the career of professor.

The essentially theoretical scientific education there given covers a period of three years and embraces nearly the entire extent of the sciences—from mathematics and physics to chemistry, physiology and biology—all taught by the most eminent professors. Professor Joubert was thus given the advantage of a magnificent scientific training, which enabled him afterward to make such remarkable studies in the most varied branches of sciences.

After having taught elementary physics in several of the provincial lycées* he returned to Paris to occupy the chair of physics in the College Rollin in 1874, and was thenceforth in a position to undertake special studies and investigations. The first was his thesis for the degree of Docteur es Sciences Physiques, on the "Phosporescence of Phosphorus," which he brilliantly sustained in 1874 Soon afterward he became assistant to the world-famed Pasteur in a series of biological researches, the results of which were published in *Comptes-Rendus* from 1876 to 1878. Professor Joubert can, therefore, be considered one of the pioneers in the theories and methods relating to microbes which have had such a happy influence on the progress of the natural sciences, and of medicine and surgery. At the same epoch he published two studies in optics, on "The Rotative Power of Quartz and its Variation with the Temperature" and on "The Influence of Temperature on the Rotative Magnetic Power."




PROFESSOR JULES FRANCOIS JOUBERT.

It was not until 1879 that, by reason of an entirely accidental circumstance, he turned toward electricity. The Jablochkoff Company, which had just been formed, was then in all the enthusiasm of its promotion stage, and flattered itself that owing to its large capital, it could monopolize for the future all systems of electric lighting; it was at that epoch that it paid $100,000 to Professor Jamin for his patent on the electric-magnetic regulation of the arc, which threatened competition with the Jablochkoff candle, but was never utilized by its purchasers. Thinking it well to secure the aid of a savant in the capacity of expert counsel, it engaged the services of Professor Joubert, who was already known for his intellectual penetration and high scientific qualities. This idea had the most happy consequences, not so much for the Jablochkoff Company, however, whose extravagant expenditures rapidly led to ruin, as for electrical science.

At that period electrical engineers groped blindly, knowing nothing either of the measurement of the currents employed, or the resistance of conductors, or of the cost and illuminating power of an arc. In order to get an idea of what was then known about alternating current machinery in France, it is sufficient to refer to the writings of Leroux (1857), of Jamin and Roger (1869) and of Mascart (1877). In other countries the situation was not much different; Maxwell had approached the question in two or three notes, but without result, and had not touched upon it in his treatise. Electricians were astonished to find that Ohm's law apparently no longer applied, and many considered the resistance of a conductor as a quantity which varied with the velocity; others, more prudent, contented themselves by adding to the formulas a term proportional to the velocity or to its square. As to self-inductance, no one thought of it.

It is to Professor Joubert that the honor belongs of having found the law of simple alternating currents, represented by the two well-known formulas

$$I=\frac{E_0}{\sqrt{R^2+\frac{2\pi L}{t}}}\sin 2\pi\left(\frac{t}{T}-\phi\right)$$

$$\text{and } \tan 2\pi\phi=\frac{2\pi}{T}\cdot\frac{L}{R}$$

which define the apparent resistance effect, called impedance to-day, and the lag in phase. It would only be just to give definitively to these formulas the name of Joubert's law.

The above formulas were not obtained as deductions from the differential equation, but they were discovered as a simple experimental law, the results being represented by an expression of the form

$$I=\frac{E}{(a^2\times R^n)^{\frac{1}{2}}}.$$

Later, he analyzed the phenomena by tracing periodic curves and interpreting them with the aid of the calculus, to-day a classical investigation. It should here be remembered how happy a chance it was that the machine experimented with by Professor Joubert was a Siemens alternator giving an E. M. F. almost sinusoidal, for otherwise he would scarcely have dared to make the hypothesis which to-day forms the necessary basis of all our calculations relating to alternating currents. At the same time Professor Joubert investigated for a particular case the phenomena of which the alternating current arc is the seat.†

In these studies is explained the method to-day well known under the name of "the instantaneous contact method" of which the applications have been so numerous and so useful. It is well to point out that Professor Joubert had indicated three methods, depending upon the employment of the electrometer, of the ordinary galvanometer, and of the ballistic galvanometer and condenser, and it is therefore incorrect to credit to others the idea of the latter combination.

The results thus far give an idea of what Professor Joubert would have been able to do in this line if his experiments had not been interrupted by the bankruptcy of the Jablochkoff Company in 1881. Happily, however, at the same period the Paris Electrical Exposition opened up a new field to his activity, and he proposed to the jury to profit from the collection of machines of such varied types to

* A lycee, or French college, corresponds nearly to the German gymnasium. Classical and scientific studies are followed from the age of 8 years to 16 or 19, when the graduate is qualified to enter the examinations for admittance to the university or State schools.

† The results of these studies are given in a slightly different form in two papers, now become classic: "Etudes sur les courants alternatifs et sur la force electromotrice de l'arc voltaique." (*Journal de Physique*, tome IX., p. 297, 1880.) "Etudes sur les machines magneto-electrique, contenant la demonstration experimentale et theorique des lois auxquelles obeissent les machines a courants alternatifs." (*Annales* de l'Ecole Normale, tome X., 1887.)

determine the principal constants by the aid of his method of measurement. These suggestions resulting in nothing, he then proceeded to work independently with Messrs. Potier, Allard, Tresca and Leblanc, and tests by this group of savants were completed with success before the official committee had finished its preparations for work.*

It was in the following year that Mascart and Joubert's "Treatise on Electricity" appeared, a book especially remarkable when we consider the period in which it was written. It was the first systematic treatise which placed the entire science of electricity within easy reach, and a happy combination of the theories of the French and English schools. In its pages the student was presented for the first time with a clear and concise exposé of the principles of the methods and the calculation of measurements and of their principal applications. The success of this treatise was enormous. It was translated into German and English and became rapidly a classic abroad as well as in France. Although now twelve years old, it yet remains the standard for electricians, who by its means have profited by knowledge otherwise difficult of access, particularly that relating to the work of Maxwell.† The publication of this work in reality crowned the scientific career of Professor Joubert, to whom it definitively assured an eminent place among the electricians of the world.

Since that time honors in France have pressed upon him. As Secretary-General of the Société de Physique from 1880 to 1890, his indefatigable activity during that long period rapidly developed the prosperity of the society, and he was elected its president for the year 1894. His work in the interest of the Société Internationale des Electriciens has not been less useful. He was also one of the most zealous organizers of its annex, the Laboratoire Centrale, where the members of the Congress of 1889 were able to see him repeat the experiments of Hertz; in its development he occupied himself especially during the years 1891 and 1892, when he filled the office of president of the Société.

In 1888 Professor Joubert was appointed Inspector-General of the Academy of Paris, and in 1892, Inspector-General of Public Instruction in France, the administrative functions of which offices have absorbed his energies in later years. His last great work was the memoire "Sur l'Electro-Dynamique d'Ampere, Davy, Faraday, etc." (two volumes, 1887-8), published in the collection of memoirs of the French Physical Society. This work is a fine monument raised to the memory of these savants, for which all electricians should be grateful to the author.

The frank and sympathetic countenance of Professor Joubert is a reflection of his character. The latter has brought him only friends, and all those who have had occasion to meet him retain the kindest remembrance of his cordial and affable welcome, so full of geniality and of consideration for all. Professor Joubert is at the same time a type of those modest savants, "modest as the violet," as his successor to the presidency of the Société Internationale des Electriciens so gracefully remarked, who, far from seeking flattery or even lending ear to the praises of the world, work silently and find their reward in the success of their work. This is a fine attribute of Professor Joubert's character, and one which has served to give to the eminent professor an extreme popularity among French physicists and electricians. I hope that this short note will aid in extending this feeling among our American confrères.

## Niagara Power at Buffalo.

According to a Buffalo correspondent the Niagara Falls Power Company is not to have an exclusive franchise for transmitting and distributing electric power to the city of Buffalo, the sub-committee of Council in charge having decided to offer no franchise for the exclusive use of any one company, believing in the axiom that "competition is the life of trade." The franchise, which is practically ready, is expected to meet with the approval of the members of both houses of the Common Council. The franchise is not a long one, but it is stated that there is liable to be considerable discussion before it is adopted and that trouble will probably come from no less a conspicuous source than the mayor's advisory committee. It was agreed at first, it is said, that the franchise, which will be in the nature of a report from the sub-committee, should be signed by the members of that committee, but it is now revealed that the mayor's committee is not entirely in sympathy with all the provisions contained in the document. A meeting of the sub committee was held behind closed doors on April 23, and only members of the sub committee were present beside Corporation Counsel Laughlin. A few immaterial changes were made in the franchise and it will be redrafted at once. It is understood that the franchise will be free from harassing restrictions. It will contain no clause compelling the companies to fix a maximum price at which to furnish electric power. One clause of the franchise which the company will be asked to sign, however, will provide that after the price has once been fixed, the company will not be permitted to increase it after consumers have gone to the trouble of removing their steam plants and equipping their works for the introduction of electricity.

The Buffalo *Express* printed on April 24 a complete analysis of the document, the substance of which is as follows:

The first part of the franchise is given over to defining that the Common Council shall approve of all of the plans and specifications of the Power Company for the distribution of its power about the city, and will have the right to regulate the size of poles and conduits to be used, and determine the quality and nature of insulation under all circumstances and conditions. The franchise will require that all poles be of sufficient size and that the conduits shall be large enough to carry the wires of two other companies, as well as the wires of the police and fire alarm telegraph of the city. It will provide that the Common Council can direct the Board of Public Works to put in proper condition any street which may be entered by the Power Company and which the company fails to repair within a reasonable time, and the expense for replacing the same shall be at the expense of the Power Company. Another provision is that if in the street in which there is a conduit, the city deems best to construct a sewer, the Power Company shall rebuild its conduit and place it in such a position in the street that it shall not interfere with the construction of the sewer.

The franchise provides further that the Power Company shall be required to place conduits in certain streets in place of poles when the Common Council of the city shall deem such change proper and for the best interests of the citizens, and also that there shall be a uniform price charged by the company in all parts of the city so that a consumer in one part shall not be able to obtain power at a cheaper rate than a manufacturer in another section, thus placing all consumers upon an equal footing. In the franchise is also a provision that if the city demands, the Power Company shall furnish power for the water works at a rate not to exceed $20 per annual horse power and shall furnish street lights at an expense not to exceed $50 a year each, or that the Power Company may have the opportunity, in place of furnishing power and lights, of paying into the treasury of the city a certain per cent. of the gross receipts each year.

If within the radius of a mile of the lines of the Power Company, power to the amount of 2,000 hp is required by consumers, the franchise requires that the Power Company shall extend its lines within six months to the various consumers who petition for power. An important provision is that the Power Company cannot raise the price of power to a consumer after once agreeing to furnish it at a certain price. It is further provided that the Power Company shall have the current ready for delivery to customers in Buffalo by Jan. 1, 1896, in quantities of not less than 10,000 hp; also, that the company shall furnish at least 10,000 hp a year for the succeeding four years until it shall be supplying 50,000 hp, provided there is a demand for so great an amount of power.

At the end of 25 years the city, if it so desires, can buy the plant of the Power Company inside its limits. The amount to be paid by the city is to be determined by an appraisal made by three appraisers, one to be appointed by the mayor and one by the Power Company, and the third to be selected by the two interested parties. The term of the franchise is to be 25 years. No price is stipulated for general consumers. The penalty for violation of any of the provisions stipulated is a forfeiture of the franchise.

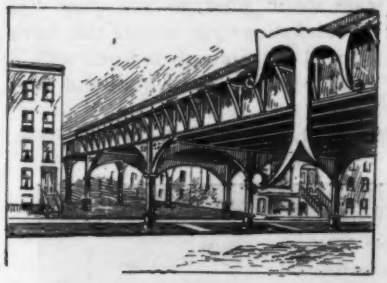
## Successor to Helmholtz.

The Emperor of Germany has just appointed Dr. Friedrich Kohlrausch to the presidency of the Imperial TechnicalInstitute, in which position he succeeds the late von Helmholtz.

* The results have been published in the well-known work entitled "Experiences faites a l'Exposition d'Electricite de 1881 par MM. Allard, Joubert Leblanc, Potier et Tresca," and have served as a model for subsequent expositions.

† The authors are preparing a second edition, which will include all the recent advances in the science. Recently Professor Joubert has written an elementary treatise on electricity, which is a model of its class in clearness and exact statement, and promises to become a classic like the great treatise of which it is an abridgement.

## The Chicago Electric Elevated Railway.

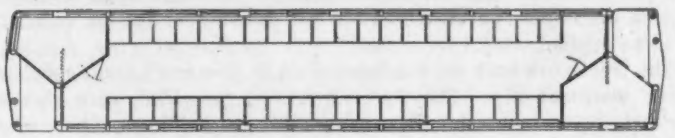


THE opening of the Metropolitan West Side Electric Railway in Chicago, on April 21, may be called an important electrical event from the fact that it will be the first elevated railway in this country to use electricity exclusively over all of its lines. The entire road, in fact, is electrical. Its motive power is electric; its cars are heated and lighted by electricity; the air brakes that control the trains are operated by electricity, and the new rolling-lift bridge across the Chicago river is operated by the same power. A contrast of electric power on elevated structures with steam is particularly favorable to the former. The noise, smoke, dirt and inevitable dripping from a steam engine overhead are entirely obviated, and already there is some talk of utilizing the spaces under the structure for rental purposes.

When the system now under way is completed it will comprise 18 miles of double track; the main line, covering a distance of 13½ miles, is erected; the Southwestern line running to Douglas Park, about 3¾ miles in length, is yet to be constructed. About two miles of the line is a four-track road and on this trains will be run on an express schedule at a speed about four times as great as that of the elevated railways in New York. At present trains are only running on the main line as far east as Canal street, about one-half mile from the business centre.

To Mr. A. F. Walcott, of New York, is due the credit for having projected this great enterprise and succeeded in interesting the necessary capital for carrying it through. The West Side Construction Company, with a capital of $3,000,000, was first organized in 1892, and about the same time $10,000,000 worth of 5 per cent. 50-year bonds were disposed of at very advantageous terms—90 per cent. of their face value—thus placing at the disposition of the company some $12,000,000 in cash.

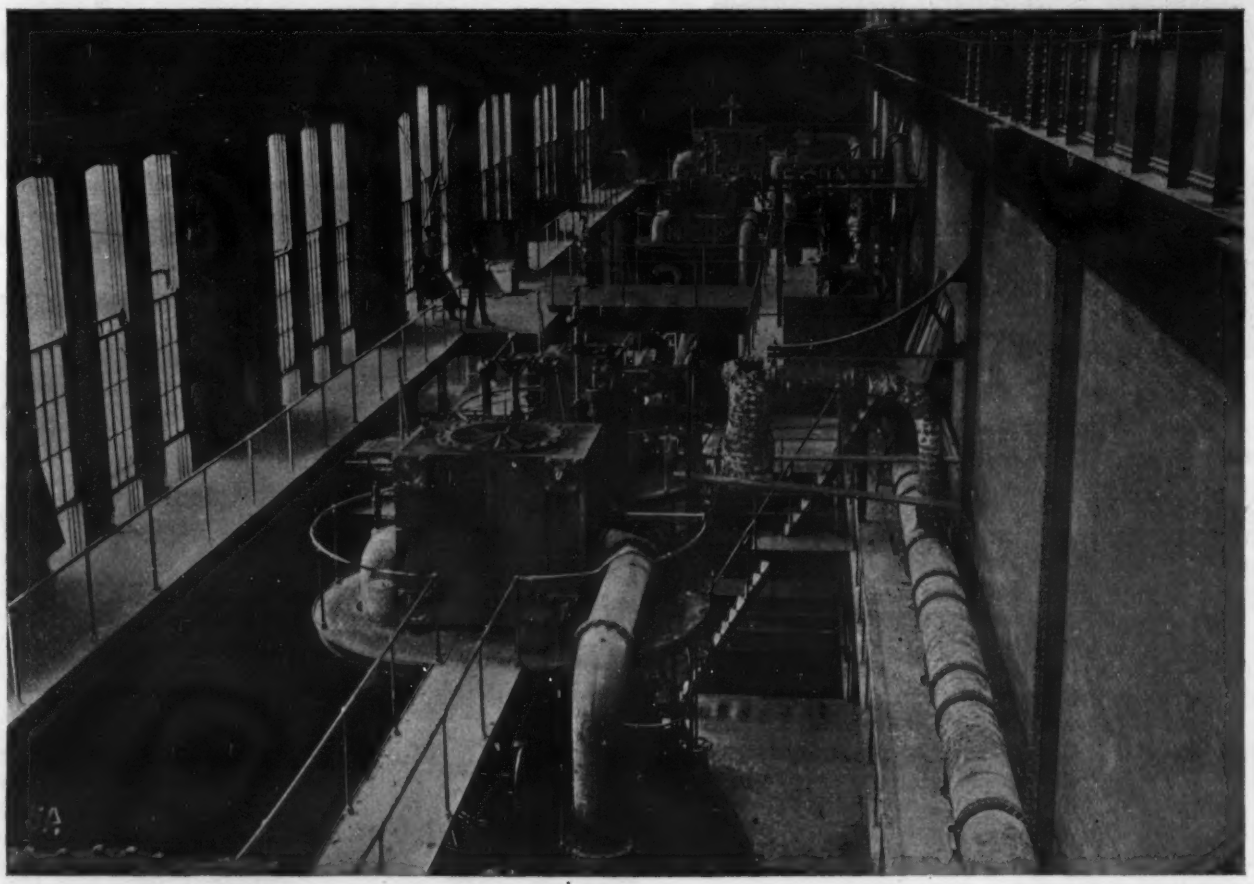
Profiting from the experience of the elevated railways of New York, it was concluded that it would be cheaper to buy a private right of way for the road than to run the risk of judgments to the extent of millions being subsequently entered for damages. As a consequence the only franchise asked from the city was the right to cross certain streets at an elevation, the line otherwise passing over private property purchased by the company. The land for the main line cost more than three and a half million dollars, and for the remainder of the system about three millions of dollars. Although the original plan did not contemplate the use of electricity the success of the Intramural road at the World's Fair led to its being employed as a motive power.



FLOOR PLAN OF MOTOR CAR.

Forty-three stations will be located on the main line and the several branches as follows: Main line, 5; Garfield Park line, 3; Douglas Park line, 11; Logan Square line, 9; Humboldt Park line, 5. The stations are all built of rock faced pressed brick, with stone trimmings, and no expense has been spared to make them meet the convenience of the patrons of the road. They are regarded as the finest structures for the purpose that have ever been constructed.

The rolling stock of the line will at first consist of 55 motor cars and 100 trailers. A plan view of one of the motor cars, which were built by the Barney & Smith Car Company, of Dayton, O., is shown in one of the illustrations. These cars furnish accommodations for smokers. The two cabs provided for the motorman, located at diagonally opposite corners of the car, are built out on the platforms as far as the hood will permit. This construction makes it necessary to locate the entrance doors next to the corner posts, and as it was thought desirable to make them of the sliding type, they are pushed back into the cab, this, however, not interfering with the motorman. The weight of the car exclusive of the electrical equipment is about 20 tons. The car body is 40 feet in length over sills and 47 feet 2¾ inches over platforms. Its characteristic feature is a steel sub-frame, which it was thought necessary to add so that the car would be strong enough to pull six loaded 40-foot trailers. It was also thought advisable to add extra weight for traction pur-



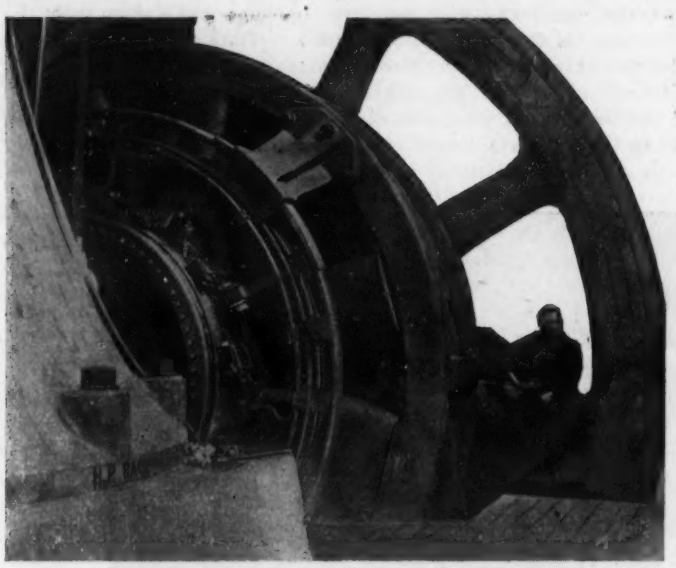
VIEW OF POWER PLANT.

poses. The sub-frame is constructed of two nine-inch I-beams located immediately under the side sill of the body.

The exterior of the cars is finished in a dark brown shade, with handsome decorations in gold leaf. The interior is finished in well polished quarter sawed oak, with a liberal amount of carving. Each motor car is equipped with two General Electric motors known as the G. E.-2,000 type. They are similar in design and construction to the G. E.-800 type, but of larger capacity and of more substantial construction. The controller is similar to the General Electric type K controller, but modified for the heavier service for which it is to be applied.

The trucks are built on the lines of an engine truck, and equal to it in workmanship. They are, however, provided with better springs, which make the cars remarkably easy riding. The trailer cars, or passenger coaches, were built by the Pullman Company. Each car will seat 48 passengers. One hundred of these are now in service. They are unusually handsome in appearance, and each is lighted and heated with electricity in the same manner as the motor cars, the heaters in all cars to be supplied by the Central Electric Heating Company.

The road will resemble in many particulars the Intramural rail-



Showing Generator Commutator.

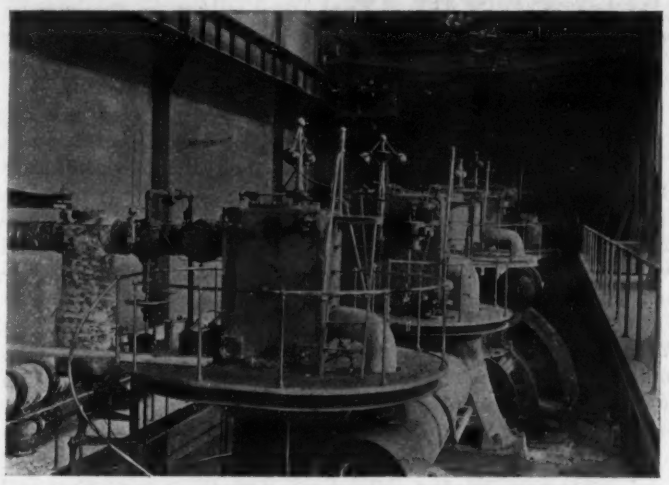
way at the World's Fair. Instead, however, of using two rails, one for a feeding and the other for working conductor, there is a single rail for the conductor and heavy cables are used as feeders, the structure furnishing the return path. As in that road, the current will be conducted by a third rail and will be picked up by a sliding shoe, which is practically the same as that used on the cars on the Intramural road. A good contact is maintained by the spring attachment, and very little sparking occurs. Each motor car is equipped with a sliding shoe on either side. If, for example, the motor car is going north, the right trolley will be in circuit. Where a cross-over is to be passed the momentum of the car will carry it over, but when it strikes the south track the shoe on the left side will be thrown in circuit. Each motor car has its controller pump and trolley contacts in duplicate, that is, at each end, so there is no necessity of loops at the terminals. The track rails are carefully bonded by two copper strips, one on each side, riveted cold through holes in the web.

The power station, which is located on Throop street, was designed by the general superintendent, W. E. Baker, for an ultimate capacity of 3,000 horse power. Its design is such that it can be doubled in size by an extension to the street, as the site of the city lighting station has been purchased by the company. The building is 300 feet in length and 90 feet in width.

The machinery foundations are constructed of brick and concrete. The engines will be six in number, all of the vertical Corliss type and constructed by the E. P. Allis Company, of Milwaukee, Wis. Four engines, two of 1,000 horse power and two of 2,000 horse power each, have been installed. The cylinders of the larger engines measure 36 and 72x48-inch stroke and those of the smaller engines are 23 and 46x48-inch stroke. The larger engines will run at 75 revolutions per minute and the smaller at 100 revolutions per mnute.

Each pair of engines is fitted with two distinct governors. One of these controls the point of cut-off, and the other is connected with a safety stop valve in the main steam pipe, so that when the speed exceeds a certain number of revolutions per minute the valve closes instantly. Each engine, it will be noticed, is fitted with a wrought iron receiver of large volume between the high and low pressure cylinders.

Some of the generator details may be obtained from the views

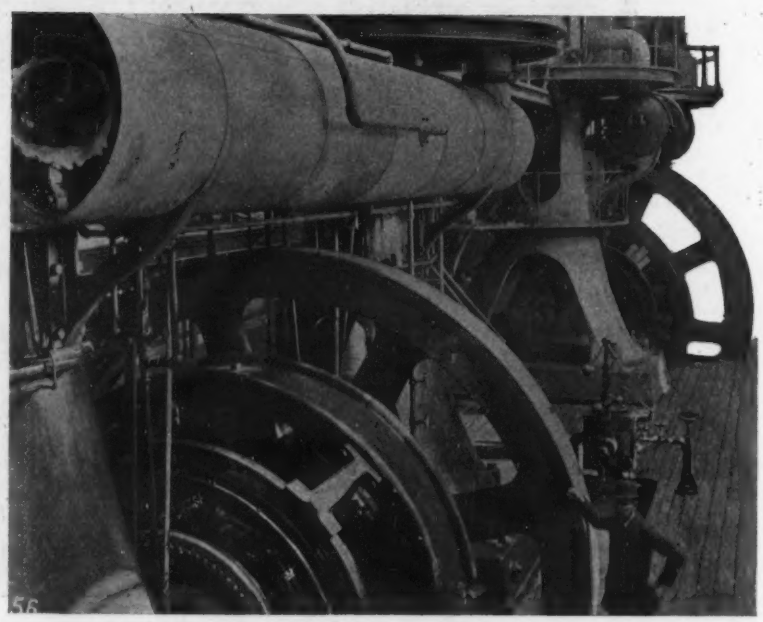


Engines as Seen from Gallery.

presented. They are of the standard General Electric slow speed, multipolar type and direct coupled to the engines. Two are of 1,500 kilowatts and two of 800 kilowatts capacity.

The switchboard, which is of the latest design manufactured by the General Electric Company, is composed of the generator and feeder panels. The former are 24 inches wide and are equipped with the latest types of instruments, including a recording watt meter and lightning arresters.

The boilers, which were supplied by the Babcock & Wilcox Com



Generators and Engine Receiver.

pany of New York, are arranged in six batteries of two boilers each, each boiler being of a capacity of 300 horse power, and provided with mechanical stokers. The arrangements for receiving fuel are very convenient. Coal is dumped directly from the cars into shutes, which convey it directly to the boiler room. The furnaces are provided with smoke-consuming devices, which seem to operate very successfully. The ashes are mechanically removed from the rear.

The officers of the company are as follows: President, Robert E. Jenkins; secretary, George Higginson; general counsel, W. W. Gurley; general superintendent, W. E. Baker; superintendent of transportation, A. S. Jones; electrical engineer, H. M. Brinckerhoff.

## Experiments with Electric Waves.

BY ALFRED G. DELL.

The following experiments on electric waves were made with the apparatus described in THE ELECTRICAL WORLD of Jan. 12, 1895, in connection with a Geissler vacuum tube seven inches long.

When the pointed spark gap was widened so that no sparks could pass and the tube was connected, one electrode with each brass plate, the bulb on the right became only partially filled with light, while that on the left was filled with a violet glow; when the current was reversed, the effects were also reversed. No sparking was obtained in a resonating circle with the tube substituted for the spark gap, and with the 2 x 3 feet zinc plates set up in front of the brass plates.

In front of the brass plates two zinc plates of the same size were attached, being placed as near as possible to the brass ones without touching, but a sufficient distance left so that no sparks could pass between the two sets of plates; two parallel bright copper wires (No. 20) each 27 feet long, were next attached, an end of each to a side of the zinc plate next the spark-gap, and an electrode of the Geissler tube connected to each wire at the other end, a wooden cross arrangement being used to support the tube and wires. Then with a bright copper wire fastened on a piece of wood, and with the current in the same direction as first noted—that is, the bulb with the violet glow being on the left—the nodes along the wires were found by placing the connecting wire across the two long wires, bridge fashion, and sliding it along them. It was found that when the connecting wire was down, the spark at the gap between the brass plates was very bright; when the connecting wire was raised the spark fell off greatly in intensity.

When the spark gap was of the proper length to give a vigorous spark the bulbs were fully lighted up, but differently, the one attached to the right hand plate being more brilliant than the left hand one, the latter still containing the violet glow as when attached to the brass plates. On reversing the current the light changed sides. When the spark-gap was very close, both bulbs were exactly alike, both containing the violet light, and under these conditions no nodes could be found along the wires. In experiments made with lengths of wire from 16 to 27 feet, the first node was next to the zinc plates and extended some inches, growing in brightness. The second node extended sometimes as much as two feet, commencing with a dim light in the tube, and extending throughout the whole tube, then growing dim again, with flashes of light in the bulbs as the connecting wire was moved along the two wires. The third node was not nearly so prominent as any of the others, it giving a pale light in the tube. The fourth and fifth nodes were very distinctly marked, the tube lighting up throughout at once, and there being no changes of any account in the light.

In experiments with wires of lengths from 6 to 14 feet, the first node was very difficult to place on account of the tube being lighted up full for a considerable distance. The second node could not be determined with any degree of certainty, only flashes of light appearing in the tube. The other nodes were well determined, but here was no great accuracy as to the first and second lengths from 6 to 14 feet, the tube lighting up fully at the first point given, and flashes being obtained at the second.

The sparks between the connecting wire and the long wires were very prominent at loops half-way between the two nodes when the former was lowered or raised, but at the nodes these sparks were very small.

| Lengths of Wires, measured from zinc plates. | 1st Node. | 2d Node. | 3d Node. | 4th Node. | 5th Node. |
|---|---|---|---|---|---|
| Feet. | Ft. In. | Ft. In. | Ft. In. | Ft In. | Ft. In. |
| 27 | 0 3 | 4 3 | 11 0 | 18 6 | 23 6 |
| 25 | 0 3 | 3 6 | 10 0 | 17 0 | 21 7 |
| 23 | 0 2½ | 3 0 | 9 3 | 15 9 | 18 8 |
| 21 | 0 0 | 2 6 | 8 3 | 14 2 | 17 0 |
| 19 | 2 3 | 7 6 | 12 10 | 15 5 | |
| 18 | 2 0 | 6 11 | 12 1 | 14 7 | |
| 16 | 1 6 | 5 10 | 10 9 | 13 0 | |
| 14 | 1 0 | 2 7 | 9 5 | 11 2 | |
| 12 | 0 6 | 2 8 | 7 11 | 9 2 | |
| 10 | 0 6 | 1 9 | 6 6 | | |
| 8 | 0 4 | 1 5 | 5 2 | | |
| 6 | 0 3 | 1 5 | 2 11 | | |
| 4 | 0 0 | | | | |

Thirteen different lengths of wire were tested. The Geissler tubes used have two quite small cup-shaped pieces of brass, to which the connecting rings are fastened. The experiments were gone over a second time, using other wire and another tube to verify the results, which are given above in tabulated form.

## The General Electric at Buffalo.

According to Buffalo and Cleveland newspapers, an effort will be made to induce the General Electric Company to consolidate all of its manufacturing works at Buffalo. A member of the company is reported to have defined the situation as follows: "The matter under consideration is the combination of several of the plants operated by the company. It has half a dozen of them, and they will probably be united. We canvassed the situation at Buffalo, and then went on to Cleveland. A Buffalo syndicate has offered to erect the buildings and give the land for the plant. The value of what they offer to give is $1,000,000. An equally valuable consideration has been offered us by New Jersey parties. Whether the works come to Cleveland or not will depend upon the terms offered. It will be difficult, probably, to overcome the proposition made by Buffalo, but the field is open. There is not a great deal of choice between the two cities, as both are convenient for supplies of fuel and for copper from the upper lakes. The works will employ from 4,000 to 6,000 men. It has not been decided whether or not the Brush works will be removed from Cleveland, in case the consolidated plant goes elsewhere. It has been settled, though, that the works at Schenectady, N. Y., will be too important to be passed upon hastily."

A dispatch from Cleveland says that on Sunday, April 21, a number of officials of the General Electric Company began to drift into that city. Among them were President C. A. Coffin, Vice-President S. Dana Green, and Treasurer J. P. Orr. Others were directors of the company and men connected with its works in different cities. Half a dozen of the visitors spent most of Monday at the works of the Brush Electric Company. Then they had a quiet little conference. Soon after the adjournment they began to depart for home, and on Tuesday afternoon only President Coffin and two or three of his associates remained.

## The Invention of the Telephone.

In a recent address Prof. Hughes says it is 30 years since his first experiments with a working telephone. In 1865 while at St. Petersburg fulfilling a contract with the Russian Government for the establishment of his printing telegraph instrument upon all their important lines, he was invited by Emperor Alexander II. to give a lecture before the royal family, which he did. As he wished, however, to present not only his own telegraph instrument, but all the latest novelties, Prof. Philipp Reis, of Friedericksdorf, Frankfort-on-Main, sent to Russia his new telephone, with which Prof. Hughes was enabled to transmit and receive perfectly all musical sounds, and also a few spoken words, though these latter were rather uncertain; at moments a word could be clearly heard, and then from some unexplained cause no words were possible. This instrument was based, Prof. Hughes states, upon the true theory of telephony, and contained all the necessary organs to make it a practical success. Its unfortunate inventor died in 1874, almost unknown, poor and neglected, but the German Government has since tried to make reparation by acknowledging his claims as the first inventor, and erecting a monument to his memory in the cemetery at Friedericksdorf.

## Transformer Patents in Italy.

The law courts at Grosseto, Italy, says the London *Electrician*, have pronounced their decision on the action of Messrs. Ganz *v.* Messrs. Siemens and Halske, which action related to alternating current patents. The decision confirms the validity of two patents granted by the Italian Government to Messrs. Zipernowsk, Déri & Blathy, in May and August, 1885, under the title of "Improvements in the means of distributing electricity," and "Improvements in inductive apparatus for transforming electric currents." The former of these patents relates to parallel distribution by means of transformers, and the latter to the construction and use of closed circuit transformers. This decision, arrived at by the law courts at Grosseto, gives the Ganz Company practically a monopoly of alternating current work in Italy. It is said to be the intention of the Ganz Company to proceed even against polyphase installations. The legal experts, it is added, were Profs. Ferraris, Grassi and Roiti.

## On the True Dimensions of the Electrostatic and Electromagnetic Units, and on the Right Use of the Terms Intensity, Strength, Force and ℋ.

BY REGINALD A. FESSENDEN.

So many electricians of eminence have written upon this subject that it requires a certain amount of hardihood upon the part of an unauthoritative writer to touch upon it. But, in general, the physicists who have treated of it have not been actively engaged in teaching, and have not, consequently, experienced to the full the effects of the few remaining imperfections of our present system of nomenclature and dimensional formulæ. When one has given an explanation, year after year, to successive classes of students, why it is that an electromotive force is not a force; why, since a force is the differential of work with respect to distance and work is of the same dimensions in electricity as elsewhere, electrical force has not the same dimensions as other forces, and the half hundred other questions which intelligent students ask of their professor, one begins to appreciate the weak points in the system. Consequently, a few words from the point of view of the teacher may be of interest.

I hope to show that the reason why force has different dimensions in the electrostatic system from that in the electromagnetic system, and from that again in the ordinary system, is because of the neglect to take into account the quantities $\mu$ and $K$; and that when these are taken into account, force has the same dimensions in all the systems.

Prof. Rucker (see Everett's C. G. S. Units, page 208, 1891 ed.) has shown (Phil. Mag., Feb., 1889), as an algebraic deduction from some of Maxwell's equations, that the dimensions of all electrical and magnetic quantities can be definitely expressed:

1. In terms of $M.$ $L.$ $T.$ and $\mu$.
2. In terms of $M.$ $L.$ $T.$ and $K$.

Expressing the electrical and magnetic quantities in terms of these quantities, we get,

| | In terms of K. | In terms of $\mu$. |
|---|---|---|
| Quantity of electricity | $M^{\frac{1}{2}} L^{\frac{3}{2}} T^{-1} K^{\frac{1}{2}}$ | $M^{\frac{1}{2}} L^{\frac{1}{2}} \mu^{-\frac{1}{2}}$ |
| Strength of pole | $M^{\frac{1}{2}} L^{\frac{1}{2}} K^{-\frac{1}{2}}$ | $M^{\frac{1}{2}} L^{\frac{3}{2}} T^{-1} \mu^{\frac{1}{2}}$ |
| Electric force at a point | $M^{\frac{1}{2}} L^{\frac{1}{2}} T^{-1} K^{-\frac{1}{2}}$ | $M^{\frac{1}{2}} L^{\frac{1}{2}} T^{-2} \mu^{\frac{1}{2}}$ |
| Magnetic force at a point | $M^{\frac{1}{2}} L^{\frac{1}{2}} T^{-2} K^{\frac{1}{2}}$ | $M^{\frac{1}{2}} L^{-\frac{1}{2}} T^{-1} \mu^{-\frac{1}{2}}$ |
| Electric potential | $M^{\frac{1}{2}} L^{\frac{1}{2}} T^{-1} K$ | $M^{\frac{1}{2}} L^{\frac{3}{2}} T^{-2} \mu^{\frac{1}{2}}$ |
| Magnetic potential | $M^{\frac{1}{2}} L^{-\frac{1}{2}} T^{-1} K^{\frac{1}{2}}$ | $M^{\frac{1}{2}} L^{\frac{1}{2}} T^{-1} \mu^{\frac{1}{2}}$ |

He then points out that in every case the ratio between the dimensions in terms of $K$ to those in terms of $\mu$ is a power of $K^{-1} \mu^{\frac{1}{2}} L T^{1}$.

Therefore, if every electric quantity has definite dimensions in terms of $L.$ $M.$ and $T.$, then $K^{\frac{1}{2}} \mu^{\frac{1}{2}} L T^{-1}$ must have dimensions $M^{0} L^{0} T^{0}$ and consequently $K\mu$ must equal $T^{2} / L^{2}$.

The writer has, however, gone a step further.

Since force should be of the same dimensions in all systems of units we have:

(1) $M^{\frac{1}{2}} L^{\frac{1}{2}} T^{-2} \mu^{\frac{1}{2}}$ (dim. of electric force at a point)
$= M^{\frac{1}{2}} L^{\frac{1}{2}} T^{-1} \mu^{\frac{1}{2}}$ (dim. of magnetic force at a point.)
(2) $K\mu = T^{2} / L^{2}$ (from above.)
Therefore,

(A) $K = M^{-1} L^{-2} T^{2}$.
(B) $\mu = ML$.

If we substitute these values of $K$ and $\mu$ in the dimensional formulæ given above, we find:

That the dimensions of both quantity of electricity and strength of pole reduce, as they should, to zero.

That the dimensions of magnetic and electric force reduce to $MLT^{-2}$ the same as the formula in the common system.

That the formulæ for electrostatic potential and magnetic potential become each $ML^{2} T^{-2}$, identical with the regular formula for work, or potential.

Similarly if we go through the whole of the dimensional formula and introduce in them the values of $K$ and $\mu$ derived from equations $A$ and $B$, we see that the whole system reduces to order, and becomes identical with the ordinary system.

Moreover this clears away all doubt as to the proper places where $K$ and $\mu$ should or should not be introduced. For instance, Dr. Bedell, in a very interesting paper on Magnetic Potential* (*Cornell Physical Review*, January) calls attention to Prof. J. J. Thomson's statement that Ampere's law for the equivalence of a circuit and a magnetic shell is correct only in a medium whose permeability is unity. He gives the amended equation:

$$\mu \times \text{current} \times \text{area} = \text{magnetic moment}.$$

Now current = quantity × time, and magnetic moment = strength of pole × length.

Hence we get the identical equation:

$$\mu \times M^{\frac{1}{2}} L^{-\frac{1}{2}} \mu^{\frac{1}{2}} \times T^{-1} \times L^{2} = M^{\frac{1}{2}} L^{\frac{3}{2}} T^{-1} \mu^{\frac{1}{2}} \times L.$$

Another and simpler way in which $K\mu$ can be proved equal to $T^{2}L^{2}$ is from the equation,

$$\text{Velocity of light} = (K\mu)^{-\frac{1}{2}} \qquad (3)$$

Whence $K\mu = T^{2}L^{2}$.

If then to the usual definition of current we add the words "in a medium of unit permeability," as Prof. Thomson has shown is correct, we have for the various magnetic and electric quantities the following:

| | Usual formulæ. Electrostatic. | Usual formulæ. C. G. S. | Electromagnetic. | Correct formulæ Electrostatic, C. G. S. and Electromagnetic |
|---|---|---|---|---|
| Quantity of elect. | $L^{\frac{1}{2}} M^{\frac{1}{2}} T^{-1}$ | | $L^{\frac{1}{2}} M^{\frac{1}{2}}$ | Zero. |
| Strength of pole | | $L^{\frac{3}{2}} M^{\frac{1}{2}} T^{-1}$ | | |
| Elec. force at point. | $L^{-\frac{1}{2}} M^{\frac{1}{2}} T^{-1}$ | | $L^{-\frac{1}{2}} M^{\frac{1}{2}} T^{-2}$ | |
| Mag. force at point. | | $L^{-\frac{1}{2}} M^{\frac{1}{2}} T^{-1}$ | | $L^{3} M T^{2}$ |
| Electric potential. | $L^{\frac{1}{2}} M^{\frac{1}{2}} T^{-1}$ | | $L^{\frac{1}{2}} M^{\frac{1}{2}} T^{-2}$ | |
| Magnetic potential. | | $L^{\frac{3}{2}} M^{\frac{1}{2}} T^{-1}$ | | $L^{3} M T^{-2}$ |
| Elect. resistance. | $L^{-1} T$ | | $L T^{-1}$ | $L^{-2} M T^{-3}$ |
| Elect capacity. | $L$ | | $L^{-1} T^{2} L^{2} M^{1} T^{2}$ | |

It will be noted that the correct formulæ are much more understandable than the usual ones. For instance, instead of resistance being a velocity or a slowness, a thing which is not easily comprehended by the average student, we see that it is really Work × Time. It is thus perfectly analogous to the work done against friction in moving masses along a plank.

For if we have a plank of a certain length, and slide a pound mass along it, from end to end, a certain amount of work is done. If we make a succession of masses slide along the plank, so that one reaches the end every second, all moving with the same velocity, then the total resistance is evidently equal to the work done in sliding a single mass multiplied by the time. Thus we get the following conception of electrical resistance.

*The electrical resistance of a wire is the work done in carrying a unit quantity of electricity from one end of the wire to the other multiplied by the time taken in doing it.*

We see also that capacity means simply the reciprocal of work: *i. e.*, that condenser which requires the least amount of work to put a given quantity of electricity into it has the greatest capacity.

The electrostatic theory of cohesion† (see *Science*, July 22, 1893) is competent to decide whether $\mu$ is a density and $K$ the reciprocal of an elasticity or vice-versa. It shows plainly that the former is true, and also that in Fizeau's experiment, the increased velocity of the light is not due to the fact that a certain amount of ether, of density $n^{2} - 1$ travels with the water, as supposed by Fresnel, but that a certain quantity of ether whose average rigidity is $n^{2} - 1$. (The reason why we do not get a current of electricity under these conditions is seen at once from a consideration of the electrostatic theory of cohesion.)

That $\mu$ is a density is proved also from considerations of equations $A$ and $B$. If $\mu$ corresponds to a density and $K$ to the reciprocal of the elasticity of the ether, we see, on substituting the values of $\mu$ and $K$ from equations $A$ and $B$, that the mass of the ether is in both cases of the dimensions $ML^{4}$ (thereby affording infinite opportunities of amusement to metaphysically inclined fourth dimensionists since our matter is the density of the ether in fourth dimensional space).

If however we take $\mu$ as the reciprocal of rigidity, we get for the dimensions of ether mass, from the one equation, $ML^{6}T^{-4}$, and from the other, $MT^{2}$, which are incompatible.

The writer has used with considerable success in his classes an

* See The Electrical World, February 16, 1895.
† See The Electrical World, Aug. 22, 1891.

ether having the following properties. Its particles have no mass, it has friction (but no frictional losses, as its atoms have no kinetic energy); it has no inertia when moved in a straight line, but possesses inertia as a whole when moved in a curved line, the amount of inertia depending on the curvature.

To the writer's surprise (for he had used it simply as the most suitable ether he could devise, and as the one best agreeing with the facts) this property is shown from the dimensional formula.

We have from equation 3,

$$m = ML^4.$$

where $m$ is the mass of the ether. Consequently we see that the ether has inertia, depending, first on its density, and second on curvature, for $m/L^4 = m/L^3 \times 1/L$. The dimensions of magnetic induction are $ML^2$.

*Intensity.*—In the phrases, intensity of magnetizing force and intensity of current, the word intensity is used in two senses. Fortunately we have a guide as to which is likely to be the more correct.

If we read pp. 11 to 13 of Maxwell, vol. 1, we are led to the following ideas:

1. If a quantity be defined with respect to length, its intensity is the amount per unit of length.
2. If it be defined with respect to an area, its intensity is the amount per unit of area.
3. If it be defined with respect to unit volume, its intensity is the amount per unit volume.

*And generally, if one quantity be defined with respect to any other quantity, its intensity is the amount per unit of that quantity with respect to which it is defined.*

This principle is followed either purposely or instinctively, throughout Maxwell's book, and by almost every modern writer. Consequently, intensity of current does not mean the amperes, but the amperes per square cm of cross section of the wire, or the current density.

We may here notice a convenient fact. It is that in every instance but one, when the quantity itself ends in "ance" its intensity ends in "ity." Thus we have:

| *Quantity.* | *Intensity of Quantity.* |
|---|---|
| Resistance, | Resistivity. |
| Reluctance, | Reluctivity. |
| Conductance, | Conductivity. |
| Permeance. | Permeability. |
| | Susceptibility. |
| Impedance, | Impedivity. (?) |
| Reactance, | Reactivity. (?) |
| Inductance, (?) | Inductivity. (?) |
| | Inductance. |
| } Admittance. | |
| } Susceptance. | |

NOTE.—See Steinmetz: Trans. Am. Inst., 1894; p. 727.

The names marked with an interrogation point have not been used as yet, but they are logically correct. For instance:

Impedivity is the impedance when the time rate of change of current is unity.

Reactivity is the $j$ compound of the electromotive force when the time rate of change of current is unity.

Inductance $= L\omega$, Inductivity $= L \times 1$.

(There is another reason for using the word inductance in this signification and not the usual one. It is that while current × resistance gives the working component of the voltage; current × reactance gives the $j$ component of the voltage; and the current × impedance gives the total voltage; the current × inductance does not give the self induction part of the $j$ component, if the word is used in its usual signification; while if we let it equal $L\omega$, it does.)

*Force.*—The terms electromotive force and magnetomotive force are productive of great confusion, and are a serious hindrance to the acquirement of correct physical ideas. Electromotive force is not a force, but the line integral of a force, and consequently is a potential. It is not only numerically equal to a potential, but has the same dimensions, and no distinction can be drawn, in any way whatever, between electromotive force and potential. If, therefore, either of the terms voltance or potance could be used it would help matters much. The corresponding intensities—voltivity and potivity—would be the drop in voltage per unit length; possibly gilbertance could be used for electromagnetic potential. Then $\mathfrak{H}$ would be the gilbertivity. The term voltage has already been proposed.

*Strength.*—When we speak of the strength of a pole we mean the quantity of magnetism on one pole of the magnet. When we speak of the strength of a magnetic shell we mean the moment per unit area of the shell. For some reasons it would be advisable to give another name to one of these quantities.

$\mathfrak{H}$.—The writer has been unable to see what difference there is, if any, between "strength of magnetic field" and "intensity of magnetizing force," and would be glad of any information on this point.

The above has been written from the point of view of the teacher. It is perfectly true that this system of nomenclature has been devised for the benefit of electrical engineers, and not for the comfort of professors. Yet there is no better test of the logical construction of a system of nomenclature than class work, and a system which has any rough spots in it will show it there first, and they will afterward surely be felt by the engineer. In this connection I would say that the new terms of the American Institute: gauss, weber, gilbert, and oersted, have saved quite an appreciable amount of labor in the writer's classes, and I believe that no one who has to deal much with the ideas which they represent will ever return to the old system. Prof. Crocker (Trans. Am. Inst., 1894, p. 154) has shown very clearly the advantage derived from having definite names to these quantities, and I can corroborate what he has said from practical experience.

I might point out that since $\mathfrak{B}$ is the intensity of $N$, we can use the terms weberance and weberity in a sense analogous to resistance and resistivity.

And in general, the use of the terminations —age,—ance, —ivity, will enable us to do with one name only, where we should otherwise have to create four. For instance, if we give the name lux to a unit, and define it with respect to an area, then the *luxage* will be the name of the quantity, the *luxance* will be the integral of the quantity over an area, and the *luxivity* will be the intensity of the luxance, or the amount per unit area.

## Curves for Winding Magnets.—II.

BY HARRISON H. WOOD.

*Construction of Curves in Set No. II.*

The symbols used in the equation from which the curves in set No. II. are plotted are the same as those used for set No. I.

$L$ = total length of wire in feet.
$R$ = total resistance.
$r$ = resistance per foot at 75° F.
$a$ = cross-section in circular mils.
$E$ = impressed electromotive force.
$C$ = current.

From equation

$$C = \frac{E}{R}$$

we have

$$C \times L = \frac{E}{R} \times L$$

and since

$$R = L \times r$$

the equation becomes

$$C \times L = \frac{E}{r} \qquad (4)$$

This equation will give a curve for each size of wire, showing the relation between current and total length of wire for any fixed value of $E$; and the curve will be a rectangular hyperbola, as were those in set No. I. These curves have been plotted in the two charts of set No. II. for each size of wire for the value of $E = 500$, values of $L$ (total length of wire) being laid off on the axis of abscissæ and of $C$ (current) on the axis of ordinates. Two charts have been used, Fig. 3 containing the curves for the smaller sizes of wire and Fig. 4 for the larger. The scale of ordinates has been shortened at suitable intervals in order to make the inclination of the curves as near 45 degrees as possible. Scales for $L$ have been plotted corresponding to the values of $E = 500$, 400, 300, 200 and 100 volts, and other values to correspond to other electromotive forces can be obtained by simple interpolation.

The limits between which the curves in this set are plotted are found as follows:

From equation

$$C \times L = \frac{E}{r} \qquad (4)$$

we have

$$\frac{1}{C \cdot L} = \frac{r}{E}$$

and multiplying by $a \cdot L$ we have

$$\frac{a}{C} = \frac{L}{E} \times a\, r$$

in which $a$ is the cross section of the wire in circular mils and $\frac{a}{C}$ is the current density in circular mils per ampere.

Since the resistance of wire is inversely proportional to the cross section, $a \times r$ is a constant and equals 10.381 at 75 degrees F. (10.381 is the resistance of one foot of copper wire having a cross section of one circular mil);
hence

$$\frac{a}{C} = \frac{L}{E} \times 10.381 \qquad (5)$$

from which it appears that the current density is directly proportional to the total length of wire, $L$, and independent of all other qualities, $E$ remaining constant. The limits of $L$ will therefore be determined by practical values of $\frac{a}{C}$, and have been taken at $\frac{a}{C} = 200$ and 1,400. Vertical lines have been drawn at those values of $L$ corresponding to densities of 200, 400, 600, 800, 1,000, 1,200, 1,400, thus making it possible to see at a glance to within a few amperes the current density at any point on the curves.

In the equation

$$\frac{a}{C} = \frac{L}{E} \times 10.381$$

it will be seen that $r$ has disappeared, and that therefore the values of $\frac{a}{C}$ apply to all sizes of wire alike.

Corrections for temperature are made for the curves in this set exactly as for those in set No. I.

$T$ — temperature in degrees F. at which the coil will be worked.
$r$ — resistance of wire per foot at $T$ degrees F.
$r_1$ — resistance of wire per foot at 75 degrees F.
$L$ — length of wire necessary at $T$ degrees F.
$L_1$ — the number to be looked for on the scale.

From equation

$$r = r_1 (.0021\ T + .8425 \qquad (2)$$

and equations

$$C \times L = \frac{E}{r} (\text{at } T^\circ \text{ F.}, \qquad (4)$$

$$C \times L_1 = \frac{E}{r_1} (\text{at } 75^\circ \text{ F.}) \qquad (4)$$

we have

$$L_1 = L (.0021\ T + .8425) \qquad (6)$$

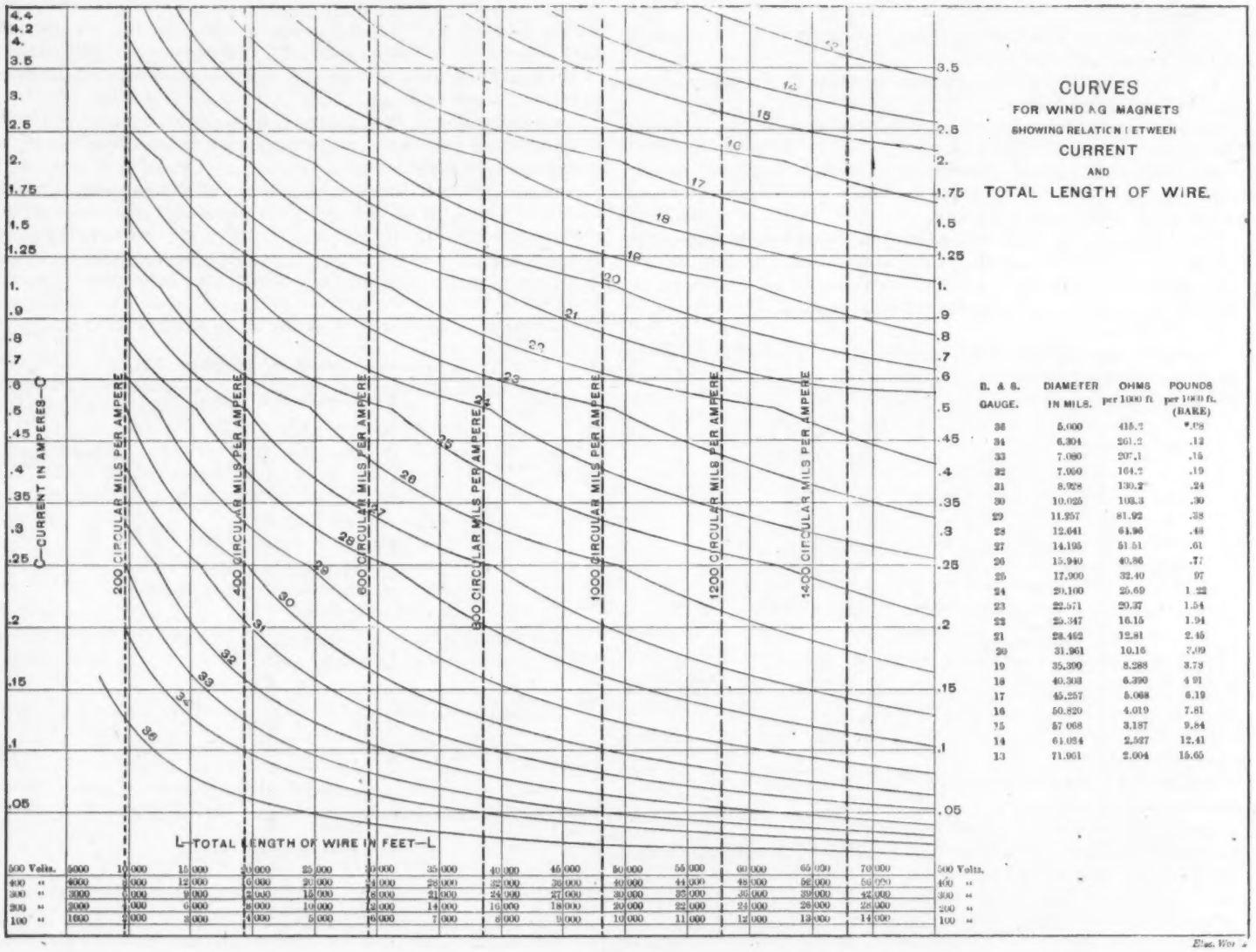



FIG. 3.

*Uses of the Curves.*

The quantities usually given in determining a field coil are the ampere-turns required, the mean length of a turn and the impressed electromotive force. With these quantities given, the curves in set No. I. will show immediately the size of wire that

will most nearly satisfy them. For instance, suppose it has been found that 15,100 $SC$ are required for a 100-volt machine, and that the mean length of a turn of the coil will be about 1.6 feet. From set No. I., Fig. 2, we find that No. 16 will very nearly satisfy these values. It shows, further, that it will exactly satisfy them if $L$ is made 1.65 feet or if $SC$ is made 15,600. From set No. II. the total length of wire necessary is shown if the field current is fixed; or if the length of wire is limited by the space it is to occupy, the resulting current is shown. Suppose the amount of No. 16 wire must not exceed 8,500 feet. The curve for No. 16 wire shows that the current will be 2.95 amperes and the density about 900. If it has been found from experiment or from empirical formulæ that with the shape of bobbin to be used a density of at least 1,300 must be allowed, to avoid overheating, the curve shows that at least 12,600 feet of wire must be used.

If $E$ has some value lying between those for which the horizontal scales have been constructed, the location of $SC$ will be found as follows:

From equation (3) we have

$$SC_1 = 12{,}080\ (.0021 \times 120 + .8425) = 13{,}220.$$

Hence we take that point on the scale for $E = 100$ at which 13,220 occurs as the abscissa corresponding to $SC = 15{,}100$ at 125 volts and 120 degrees F.

Corrections for temperature and electromotive force on the charts of set No. II. may be illustrated as follows:

Suppose No. 11 wire has been found from the curves of set No. I. to satisfy the given conditions; that $E = 250$, $T = 125$ degrees F., and that 10 amperes is the field current desired. From Fig. 2 we see that for 10 amperes, 40,000 feet of No. 11 wire would be required if the E. M. F. were 500, and the temperature 75 degrees. For 250 volts the amount of wire will be

$$\frac{250}{500} \times 40{,}000, \text{ or } 20{,}000 \text{ feet.}$$

From equation (6) we have

$$L_1 = L\ (.0021 \times 125 + .8425)$$

$L_1$ is the length for 75 degrees, and $L$ for 125 degrees. Hence

$$20{,}000 = L \times 1.115 \text{ and } L = 17{,}940.$$

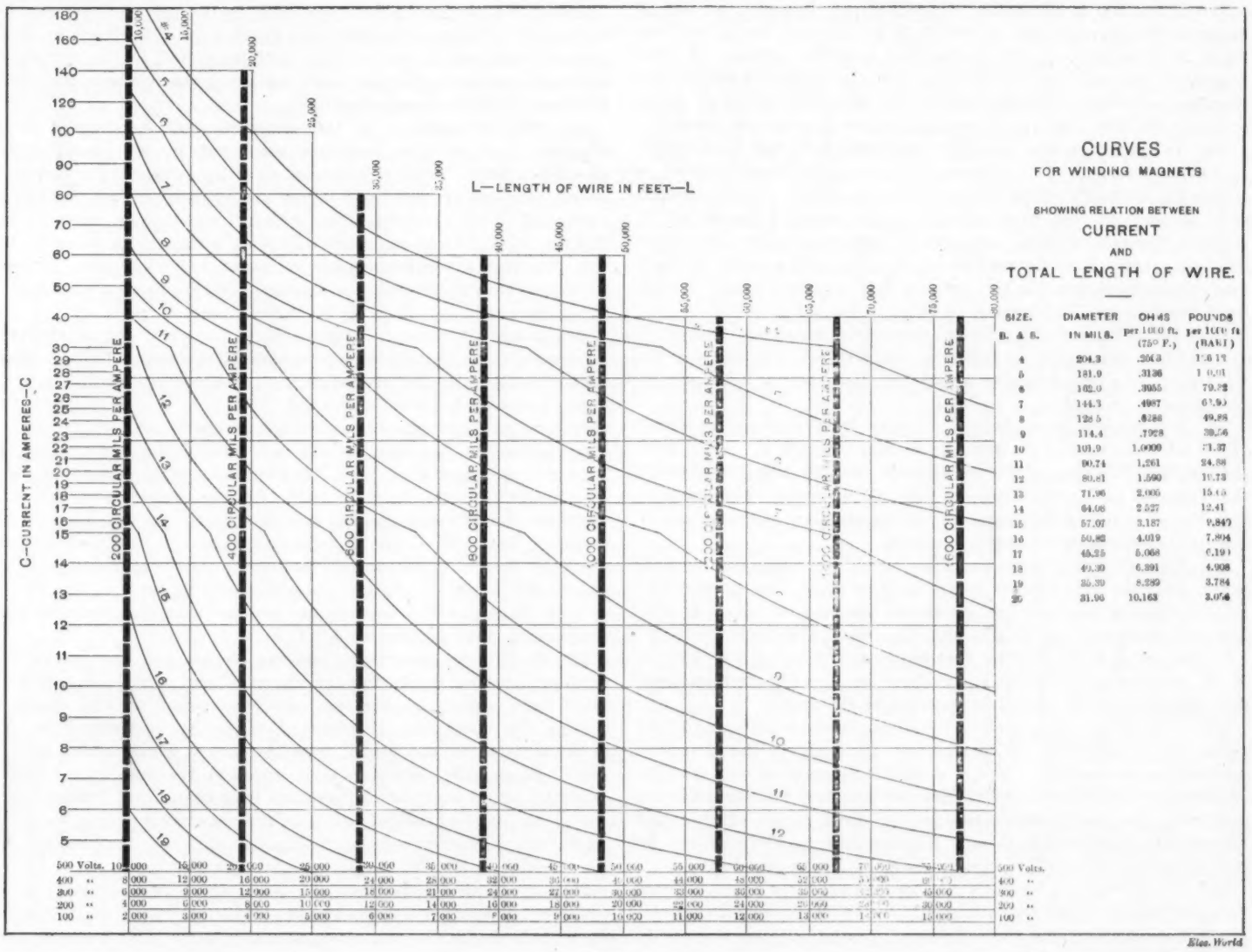



FIG. 4.

Suppose $E = 125$ volts in the above illustration. Then 15,100 $SC$ will occur on the scale at that point where $\frac{100}{125} \times 15{,}000$, or 12,080, occurs on the scale for $E = 100$. If $E = 60$, $SC = 15{,}100$ would occur at that point where $\frac{100}{60} \times 15{,}100$, or 25,170, occurs on the scale for $E = 100$.

To correct for temperature:

$SC$ desired $= 15{,}100$.
$E = 125$
$T = 120°$ F.

The correction for $E = 125$ has already been made and it has been found that the corresponding point on the scale for $E = 100$ is 12,080.

Hence 17,940 feet of No. 11 wire will be necessary to give the proper number of $SC$ at 125 degrees with $C = 10$. The density corresponding to 10 amperes in No. 11 wire, as will be seen from the curve, is about 820.

If instead of current we have the length of wire fixed at, say, 25,000 feet, the corrections will be made as follows:

From equation (6)

$$L_1 \text{ (at } 75°) = 25{,}000 \times (.0021 \times 125 + .8425) = 27875.$$

This number at 250 volts corresponds to $\frac{500}{250} \times 27{,}875$, or 55,750 on the scale for 500 volts. From the curve for No. 11 wire we find that 55,750 feet on the scale for $E = 500$ corresponds to 7.2 amperes, and at the density of 1,200.

## Electrodynamic Machinery.—XXXIV.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

201. The activity wasted in any generator invariably takes the form of heat. These expenditures are:

(1) $I^2R$ activity in the field magnets.

(2) $I^2R$ activity in the armature winding.

(3) $I^2R$ activity in eddy currents, in armature and field.

(4) Hysteresis losses in armature core and field poles.

(5) Friction in bearings and brushes.

(6) Friction in air.

202. The number of watts expended in the field magnets is equal to the product of the pressure in volts at the field terminals, multiplied by the current in amperes passing through the field. In series-wound generators, where the armature sends its entire current through the field magnets, this expenditure varies with the load. Thus, in a 10-kw series-wound generator, designed to supply a maximum current of 200 amperes at 50 volts pressure, if the resistance of the field magnet coils, when warm, be 0.01 ohm, the pressure at the terminals of the magnets will be $200 \times 0.01 = 2$ volts, and the activity, $2 \times 200 = 400$ watts. On light load, however, of say 20 amperes, the pressure will be $0.01 \times 20 = 0.2$ volts, and the activity $0.2 \times 20 = 4$ watts, so that, in the first case, the amount of heat generated in the field winding is 100 times greater than in the second case, and the temperature which the field winding would attain in the first case would be much higher than in the second.

203. In a shunt-wound generator, the activity in the field circuit is nearly constant. For example, a 10-kw generator, intended to supply 111 volts at its terminals, at full load, with a current strength of 90 amperes in the main circuit, might supply a current of 2.5 amperes through its field magnets. Consequently, the activity in the field magnet circuit would be $111 \times 2.5 = 277.5$ watts. At light load, the current strength through the field magnets would have to be reduced to say 2.0 amperes, in order to keep the terminal pressure at 111 volts, and the activity in the field would be reduced to $111 \times 2.0 = 222$ watts, so that the temperature attained by the winding on the field magnets would not be much greater at full load than at no load.

204. It is evident that the $I^2R$ activity in the armature always varies with the load; *i.e.*, with the current strength $I$. At no load, this loss must be very small, the current strength being limited to that required for the excitation of the field magnets. The temperature elevation of the armature, due to the armature winding, consequently, increases rapidly with the load.

205. The activity expended as $I^2R$, in eddy currents in the field poles, or in the armature, is nearly uniform at all loads, especially in shunt-wound machines, in which the intensity of magnetic flux is nearly constant, and if this intensity were absolutely uniform; *i.e.*, if there were no drop in the armature, requiring a greater M. M. F. and exciting current, and if there were no armature reaction, the eddy current loss would be constant at all loads.

206. The activity expended in hysteresis in the armature and field poles would, similarly, be constant at all loads if the magnetic intensity were constant. As the magnetic intensity is increased by an increase in the M. M. F. of field and armature at full load, the hysteretic loss increases, following the 1.6th power of the local magnetic intensity at any point. The temperature elevation due to this amount of heat is developed principally in the armature.

207. The friction in bearings and brushes produces heat at those parts. The amount of heat liberated, due to pure friction, is comparatively small when the lubrication of the bearings is properly attended to. In large generators, the heat produced by the friction of the brushes on the commutator is very small compared with the heat developed by the sparking, and the powerful currents set up in the short circuited coils undergoing commutation.

The friction due to the churning of the air is comparatively small in drum armatures, but often constitutes an appreciable loss in alternators, when a Gramme-ring armature of large diameter and rough exterior is revolved at a high speed. In this friction the heat is principally developed in the surrounding air and not in the mass of the machine. The air churning assists, on the contrary, in cooling the machine.

208. The expenditure of energy as heat in a generator is objectionable, first, because it represents loss of power and consequently reduced efficiency. Ten per cent. of loss in the generator due to all these causes combined, means 10 per cent. more coal, 10 per cent. more water, and engines and boilers larger by 10 per cent. to supply a given electrical activity, than would be necessary if it were possible to avoid these losses entirely; and second, because the heat developed may raise the temperature of the generator to a dangerously high degree and ultimately limit its output.

209. There are four limitations to the output of a continuous-current generator; viz.,

(1) Insufficient mechanical strength to withstand the mechanical forces brought into play.

(2) Insufficient efficiency, or insufficient pressure at the brushes, under load.

(3) Excessive sparking.

(4) Excessive heating.

The first two cases of limitation can always, by proper design, be obviated in all but the smallest generators. It is the third and fourth considerations which limit the output in all practical cases. In modern machinery it is the heating which first limits the output.

210. The limiting temperature of the generator armature is dependent upon a variety of considerations. In the first place, the hotter the armature winding, the greater its resistance; for, if $r$, be the resistance of the armature at 0° C. its resistance $R$, at any temperature $t$° C., will be approximately, $R = r(1 + 0.004\,t)$. In other words, the resistance will rise by 0.4 per cent. per degree centigrade of temperature elevation above zero. The result is, that at high temperatures, the wasteful activity as $I^2R$, in the armature increases, increasing thereby both the loss in the machine and the tendency to temperature elevation.

211. The temperature of the armature must not exceed that at which any of the materials employed in its construction would be deleteriously affected; *i. e.*, either softened or decomposed. In many generator armatures, cotton is the insulator employed, four thicknesses of cotton (representing each about 1-130th of an inch) separates adjacent wires, except at specially protected places, where mica and oil paper are employed. Cotton undergoes slow thermolysis, or decomposition by heat, at a temperature approximately that of the boiling point of water, or 100° C. Consequently, it is unsafe, in practice, to maintain cotton covered armatures, even though shellac varnished, at a higher temperature than 100° C. If the temperature of the room, in which a generator is operated, never exceeded 30° C. it would require an elevation of 70° C. in the armature to reach a dangerously high temperature. As, however, some engine rooms attain, in summer, a higher temperature than 30° C., and since a margin has to be left for accidental overloads, 50° C. is the temperature elevation that the armature should not exceed at full load, and modern practice is reducing this to 40° C.; so that the temperature of the armature, as observed after several hours of full load, is usually specified not to exceed 40° C. of temperature elevation above the surrounding air.

U. S. Navy specifications usually require that the elevation of temperature shall not exceed 50° F. = 27.8° C.

212. Many large generators, however, do not use any insulation for their armature conductors, except mica, and such generators can safely carry a much higher temperature elevation without danger.

Here the dangerous temperature, so far as mechanical injury of the armature is concerned, would be that at which solder would melt. Electrically, however, the increase in the resistance in the armature would constitute a limitation long before this temperature would be reached, and if, in fact, the armature winding were to attain this temperature, the field coils, and even the bearings of the machine, might be dangerously overheated.

213. The activity in the field coils, which will elevate their external temperature a given number of degrees centigrade, depends upon their shape, size and arrangement, whether their surfaces are freely exposed to the air, or are partly sheltered from it. Usually, however, the surfaces of the field coils must afford 16 square centimetres, or about 2.5 square inches per watt of activity developed in them as $I^2R$ heat. If the field winding consists of many layers of fine wire, the temperature of the deep seated layers will be greater than that of the superficial layer, but if, on the contrary, the layers be few, and the wire coarse, the difference of temperature in the winding will be inconsiderable. The increase of temperature on the field magnets of a generator is usually not greater than 30° C. at full load.

214. In the case of the armature, the speed at which it revolves through the air greatly increases its capability for dissipating heat and reducing its temperature, so that a much greater thermal activity can be permitted in the armature than in the field coils. The usual allowance for eddy currents, load currents and hysteresis losses combined, is about 1-5th watt per square centimetre; *i. e.*, 1⅓ watts per square inch of armature surface, including the surface

on the sides of the armature, but excluding its internal core surface, or about three times more activity per unit area than on the field magnets. In some specially ventilated armatures, in which the core discs are spaced and separated at intervals, to permit the circulation of air from the interior outward by centrifugal force, the dissipation of heat can be so far increased that two watts per square inch of armature surface have been rendered practicable. Much depends, however, upon the shape and size of the armature, as well as upon its peripheral speed, so that no exact rule can be laid down.

(To be continued.)

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## Rope Driving—XIV.

BY J. J. FLATHER.

[Owing to unavoidable circumstances the publication of Prof. Flather's article was interrupted, and in order that the concluding portions may be more easily followed, we print below a synopsis of the installments that have previously appeared.]

Art. I.—Introduction of rope driving by Combe and Barbour about 1860. Advantages of ropes. Ropes have, to a large extent, replaced the toothed gearing formerly used in English mills, but while the advantages of smooth running and easy handling are conceded, it is also acknowledged that the extra weight and greater width of pulleys increase the journal friction over that found with toothed gearing, and that otherwise a greater loss of power occurs, due to causes considered subsequently. General discussion of mill friction.

Art. II.—Examples of rope driven mills, showing distribution to various floors; rope wells. In multiple rope system each wind consists of a separate endless rope stretched around the fly wheel and its individual shaft pulley. In the continuous wind system one rope is wound continuously back and forth around fly wheel and pulley, making as many wraps as required, thence over a tension pulley or tightener and back to the starting end. Forms of tension carriages. Effect of atmospheric changes on length of rope.

Art. III.—Rope driving applied to dynamos. The usual high rotative speed of armature requires a large driving wheel or intermediate jack-shaft in order that the dynamo pulley shall not be too small. Much trouble is experienced in such drives where too little attention is given to size of pulley; where absolutely necessary to use a small pulley, the number of wraps should be increased so as to reduce the load on each. Coil friction. Winder pulley used by Sir Christopher Wren, 1670.

Art. IV.—Winder pulley applied to rope drive in Fifty-second street electric power house of the Chicago City Railway Company. One of the greatest fields of usefulness for rope driving is in the transmission of power to a moderate distance under conditions which are unfavorable to the use of belts or shafting. With rope driving one is enabled at a comparatively small cost to transmit power in any direction to a building remotely situated from the source of power, which would otherwise require an expensive line shaft or an independent engine or motor. The facility with which it may be carried in any direction across rivers, canals and streets, up hill or down, over houses and into buildings, is a feature very favorable to the further extension of rope transmission; but the rapid progress which has been made in the development of electrical transmission has limited the economical application of ropes to moderate distances. There are, however, certain limits between which the transmission of power by ropes is yet more efficient than by any other known method.

Art. V.—Example of power transmission by ropes to moderate distance, 600 hp about 200 feet and 600 hp about 185 feet. Discussion of power transmission by shafting: for wrought iron shafting the friction loss of bare shaft is:

$$L.P_0 = \frac{L}{d} \times \frac{HP}{1250},$$

in which $L$ = length of shaft in feet.

$d$ = diameter of shaft in inches.

$HF$ = allowable horse power which may be transmitted by shaft.

Art. VI.—Cotton and manilla ropes. Cotton ropes are generally softer and more pliable than the ordinary manilla ropes, allowing smaller pulleys to be used with less injury to the fibres; there is also an advantage in that there is less internal chafing and wear on account of the smoothness of the unit fibres, and the great elasticity of the yarns. Manilla fibres are composed of a number of very fine cells which look like a bundle of tubes stuck together with jagged protections along the surface. The fibres are strong lengthwise but weak transversely; when made into rope they are compelled to slide on each other while under pressure, causing internal chafing and grinding which, if not prevented, soon wears out the rope when subjected to much bending.

Art. VII.—Twist in ropes. In general, the greater the twist the harder and more rigid the rope, and the better it will keep its form; but it is not as strong nor as pliable, weight for weight, as the more loosely twisted rope; for this reason the latter is to be preferred for power transmission purposes. Lubrication of ropes. Although the rope is materially weakened by the application of grease, yet the greater freedom of the fibres permits a heavier working strain to be carried, for it is the relative wear of the fibres that determines the life of the rope. A manilla rope with its fibres properly lubricated will, under the same conditions, outlast from two to four similar dry-laid ropes which are allowed to run dry. For cotton ropes, which are not usually lubricated, a coating of beeswax and black lead, with a little tallow, forms an excellent moisture proof covering and prevents the fibre from rising and the ropes from fraying. Manilla ropes are usually laid up in tallow or paraffine, or a mixture of graphite and tallow. Area of rope: Actual area determined by sectional prints $= 0.636\ d^2$ inches, $d$ being the diameter of the rope. The actual area of a 3-strand rope equals eight-tenths of the area of the circumscribing circle.

Art. VIII.—Strength of ropes. For manilla rope, the ultimate strength $= 100\ d^2\ x$ in which $x$ is an empirical coefficient equal to $81-9d$. This gives the strength of a new dry rope made of selected stock; when wet or greasy, the strength will be reduced from 20 to 30 per cent. The strength is, however, secondary to flexibility; the normal working strain should not exceed about 5 per cent. of actual breaking strength. Ordinarily $200\ d^2$ pounds may be used as the normal working tension in rope. This is an economical load for the lasting qualities of the rope; in many cases, the more convenient adaptation of smaller ropes and the use and lesser cost of smaller pulleys outweigh the greater economy obtained by the larger ropes, and loads are carried far in excess of that given.

Art. IX.—Discussion regarding selection of rope diameter. Under similar conditions and proportional stress, we should expect a rope to wear out more than twice as fast as one twice its size; practical considerations limit the diameter of ropes between ½ inch and 2 inches ordinarily, but it is better to use a diameter not less than ¾ or ⅞ inch, where it is possible to use the larger pulleys required. Coefficient of friction, $f = 0.12$ cosec $\frac{\Theta}{2}$, where $\Theta$ = angle of groove. Determination of horse-power.

Art. X.—Tables of constants and horse power transmitted by different sized ropes under varying conditions. Effect of centrifugal force. At speeds less than 2,000 ft. per minute, the power absorbed by centrifugal force is very small and may be neglected as far as practical results are concerned. Beyond this the loss increases rapidly, until at a speed of about 8,500 ft per minute the whole allowable tension ($200\ d^2$ pounds) is absorbed. Relative wear and first cost of rope shows that the best speed is about 4,500 ft. per minute for a permanent installation working under a stress of $200\ d^2$ pounds.

Art. XI.—Discussion of the catenary. Deflection of rope, $h = \frac{wl^2}{8T}$ in which $h$ = sag of rope in feet; $w$ = weight of rope $= 0.32\ d^2$ pounds per foot; $l$ = distance between pulleys in feet and $T$ = tension in rope. Hence when a predetermined tension is required, make the sag conform to above value of $h$. When a tightener is used, the initial tension can be made equal to $\frac{200\ d^2}{2.46}$ pounds. This includes weight of tension carriage in a vertical arrangement of tightener.

Art. XII.—Loss in engine friction is practically constant. While we may speak of the friction as being a certain percentage of the horse power of an engine, it must be understood to refer to the rated indicated horse power; at less than rated power the percentage of loss due to friction will be greater and at maximum power the percentage will be less. We may expect ordinarily that the frictional resistance will vary from 8 to 13 per cent. of normal load. Compound engines of the better class should not absorb more than about 10 per cent. and triple expansion engines not more than 12½ per cent. under full load. For small engines, either single or compound, there is probably little difference between the internal resistance, whether geared with ropes or flat leather belts. With larger engines, however, the journal friction is presumably less in engines employing ropes than in those using belts. The difference

is, however, not great, and since the actual resistance in any case is also dependent upon peculiarities of type and construction, the lower values of engine friction previously given, viz.: 8 per cent. of normal horse power may be considered to hold good for rope driving plants of medium size, while 10 to 12 per cent. of the normal horse power may be taken as suitable for the larger class of engines running under favorable conditions.

Art. XIII.—General discussion of friction of shafting in factories. Belts running from the fly wheel to the main shaft and from that to a secondary or countershaft produce a load on the shaft depending upon the resultant of the several belt pulls. In addition, there is the weight of shafting and its furniture—pulleys, couplings and clutches. The resultant of these forces will be the effective load on the bearings.

The consideration of the intensity of these forces and the percentage of loss due to friction in shafting of varying diameters and lengths will be discussed in the present article. Following this the various losses peculiar to rope driving will be taken up, and the forms and proportions of rope pulleys will be considered in detail.

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Assuming an angle of 30° with the horizontal for the line of action of the resultant pull on the bearings due to the tensions in the tight and slack sides of the main belt, the combined horizontal pull on the bearings will be:

$$\cos 30° \times \frac{1}{4}\left(\frac{3}{2} d^3 N\right) + \frac{3}{2} d^3 N = 1.2 \left(\frac{3}{2} d^3 N\right);$$

and the vertical pull will be, when $W_s$ is the weight of loaded shaft:

$$W_s + \sin 30° \times \frac{1}{4}\left(\frac{3}{2} d^3 N\right);$$

therefore, the resultant of both horizontal and vertical forces acting on the bearings will be

$$W = \sqrt{\left[W_s + \sin 30° \times \frac{1}{4}\left(\frac{3}{2} d^3 N\right)\right]^2 + \left[1.2\left(\frac{3}{2} d^3 N\right)\right]^2}.$$

As previously shown the horse power necessary to overcome journal friction will be

$HP_0 = \frac{Fv}{33000}$ where $F$ is the force of friction at the circumference of shaft. If the bearing is well worn and fitted to its shaft, the resistance due to friction will probably lie between the limits $\frac{\pi}{2}\phi W$ and $\frac{4}{\pi}\phi W$, where $\phi$ is a coefficient which, from the results of experiments on shafting, we have assumed equal to 0.06, and $W$ is the resultant load, in pounds, on the bearings.

From the lesser of these values there is obtained $F = \frac{4}{\pi}\phi W$; but we have assumed that the weight of a loaded shaft varies from two and one-half to four times the weight of shaft; taking an average value of three for line shafting and noting that the weight of shaft per foot of length equals $\frac{\pi}{4}(3.36\, d^2)$ we have the friction on a loaded shaft $L$ feet long due to its weight =

$$\frac{4}{\pi}\phi 3\left(\frac{\pi}{4} \times 3.36\, d^2\right) L.$$

Substituting the value of $W$ when the belt tensions are taken into account and noting that $W_s = \frac{\pi}{4}(3.36\, d_s\, L)$ we have for the total friction load

$$F = \frac{4}{\pi}\phi \sqrt{\left[3\frac{\pi}{4} \times 3.36\, d^2 L + \sin 30° \times \frac{1}{4}\left(\frac{3}{2} d^3 N\right)\right]^2 + \left[1.2\left(\frac{3}{2} d^3 N\right)\right]^2}$$

$$= \sqrt{[0.6\, d^2 L + 0.014\, d^3 N]^2 + (0.14\, d^3 N)^2}.$$

From the formula for the power absorbed by friction we obtain

$$Fv = HP_0 = \frac{F \pi d N}{33000 \times 12} \text{ or } HP_0 = 0.0^5 8\, d\, NF;$$

hence the ratio of power absorbed by friction to the horse power which the shaft is capable of safely transmitting will be

$$\frac{HP_0}{HP} = \frac{0.0^5 8\, d\, N F}{0.01\, d^3 N} = \frac{0.08\, F}{d^2} \text{ per cent.}$$

From this expression the following Table (XIII.) has been computed for the given diameters and lengths of shafting running at 100 and 250 revolutions per minute, the belt speed for the secondary belts being assumed at an average of 660 feet per minute.

For intermediate belts having a greater average velocity than that assumed, viz., 660 feet per minute, the friction horse power for a given number of revolutions will be less than that given in the table. Thus, if the average velocity of cross belts equal 2,640 feet per minute, the horse power transmitted being the same, it follows that the tensions in the secondary belts will be one-fourth of that obtained with the lesser speed; if the main driving belt have the same velocity, the tension in this belt may be considered equal to

TABLE XIII.—POWER ABSORBED BY FRICTION IN LINE SHAFT.

| Diameter of Shaft in Inches. | Revolutions per Minute. | Percentage of Loss when Length in Feet = | | | |
|---|---|---|---|---|---|
| | | 100 | 200 | 300 | 400 |
| 2 | 100<br>250 | 5.5<br>7.8 | 10.1<br>11.6 | .....<br>..... | .....<br>..... |
| 2⅛ | 100<br>250 | 5.8<br>8.9 | 10 3<br>12.4 | 15<br>16.6 | .....<br>..... |
| 3 | 100<br>250 | 6.1<br>9.9 | 10.4<br>13 | 15<br>17.2 | 19.6<br>21.5 |
| 3⅛ | 100<br>250 | 6.8<br>11.4 | 10.6<br>14.2 | 15.4<br>18 | 20<br>22 |

Line of action of resultant of main belt tensions = 30°.
Velocity of main belt 2,640 feet per minute. Belts from line shaft are horizontal and run at an average of 660 feet per minute.
All the belts are assumed to drive from one side of the shaft toward the engine. Weight on bearings three times weight of bare shaft.

that existing in the intermediate belts; therefore, as the velocity of the belt increases for a given horse power and speed of rotation, the sum of the tensions acting on the bearings will decrease, and the maximum horse power transmissible by the shaft will be exerted with a decreasing friction loss.

If, in any case, the shafts are belted vertically or at any other angle than that assumed, the formula for $F$ will be modified accordingly.

(To be continued.)

## Induction Motors.

*To the Editor of The Electrical World:*

Sir: I have been interested in looking over Mr. Rothert's note on non-synchronous induction motors, which contains several considerations of interest from a theoretical point of view. I desire, however, to take sharp exception to his statement, which may have been derived from foreign authors making the same egregious blunder, that the insertion of a resistance in the secondary circuit of an induction motor involves the use of collecting rings and brushes.

The General Electric Company has at present in successful operation nearly thirty 3-phase and monocyclic plants, a large proportion of which are equipped with induction motors. Of these every one which has been sent out is arranged with a resistance in the secondary circuit at starting which, as Mr. Rothert says, produces a powerful starting torque with but a small current at the moment of starting. None of these motors, save a single one intended to run at a wide variety of speeds, possesses either collecting rings or brushes. In every case the starting resistance is put inside the rotating member of the motor and short circuited either all at once or in several successive steps by a solid brass ring sliding along the armature shaft and actuated by a small handle close to the bearing of the motor; an arrangement which gives absolutely no trouble and effects the result in a very simple and efficient manner.

Inasmuch as, so far as I have been able to ascertain, this particular type of polyphase motor forms not less than half of all the non-synchronous induction motors in operation in the world, I must object very strongly to the statement on the part of Mr. Rothert or anybody else that collecting rings are necessary for the successful operation of a motor having initial resistance in the secondary.

Louis Bell.

Chicago, Ill.

## Telephone Service in Venezuela.

Telephony is becoming more and more recognized in Venezuela as a commercial necessity and the service is rapidly growing. The Venezuelan government has recently contracted with the American Electric and Manufacturing Company for the establishment of telephone service throughout its public offices, connections being also provided with the existing lines between Caracas, La Guayra, Las Tegues and other points. There are already in operation several long-distance lines between remote points, with good prospects for an increase in the number.

# DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

*Note.*—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors, or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 927 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French, or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

## DYNAMOS, MOTORS AND TRANSFORMERS.

*Alternators in Parallel.*—The "Elek. Zeit.," April 11, reprints a long abstract of the recent paper of Messrs. Bedell and Ryan on "Action of a Single Phase Synchronous Motor" (see ELECTRICAL WORLD, March 30, p. 391, and April 6, p. 422), and comments on it editorially. In the editorial it is stated that three theories have been advanced for the parallel coupling of alternators, that of Dr. Hopkinson, that of Mordey and a third which leads to the conclusion that the resistance is in all cases objectionable and that a certain minimum self-induction is absolutely necessary to insure parallel running or driving of motors; these three different theories, all of which are due to competent authorities, cannot all possibly be correct in the whole of their scope, even though each may have been confirmed practically; in the Hopkinson theory for instance the condition of the equality between the resistance and the reactance seems to be confirmed by the fact that by decreasing the reactance the alternators will run better in parallel; the reverse however is not the case, as with an increase of the resistance parallel running becomes more difficult; Mordey and his followers have omitted to notice that armatures without iron still have a very decided self-induction and that therefore the condition of a negligibly small reactance cannot in practice be fulfilled even approximately; experiments with the Mordey and similar machines therefore furnish no proof for the assumption that parallel running is rendered more reliable the smaller the self-induction; the third theory was also substantiated in practice by the fact that in general there is absolutely no difficulty in running such machines, with iron in the armature, in parallel or to use them with motors. In view of these differences of opinion regarding the nature of parallel running, the experiments described in the paper of Bedell and Ryan are claimed to be of great value; the results are briefly summarized as follows: If the generator and motor were constructed with absolutely no self-induction, transmission of power at equal voltage would be impossible, it would be possible only if the voltage of the motor was less than that of the generator; in practice alternators which have self-induction can be used for the transmission of power with equal voltage as also when the motor voltage is less or greater and the action of the motor will be more stable if its self-induction has a certain value; the results show very clearly that the first motor used had not enough self-induction and that transmission became possible only after a self-induction was added to the circuit; they also show that when the circuit contains the smallest required self-induction the action will be more stable within a wider range; another valuable result is to show the practical value of vector diagrams for the predetermination of the action; the graphical treatment of alternating current problems is extremely simple; they have also shown that there are really no objections to the graphical method and that it is not necessary to make use of complicated mathematical treatments.

*Efficiency of an Alternating-Direct-Current Transformer.*—In "L'Elettricista," April 1, Mr. Arno publishes the results of some experiments undertaken on a plant converting alternating into direct currents This plant which is fed by a 5-hp Ganz transformer, connected to the supply mains of Turin, consists of a Brown non-synchronous motor, belted to an Oerlikon dynamo. At full load the motor absorbed 83 amperes at 104 volts, and 6,411 watts, the power factor being therefore 0.75; the speed was 1,224 revolutions per minute and the frequency 40. The dynamo gave 47 amperes at 64 volts; the commercial efficiency of the whole plant was therefore 0.48. This low figure is attributed to the use of belting, and the complicated arrangement of the plant, the motor and the dynamo not being combined into one machine.

*Uncoupling Shunt Motors.*—Klingelfuss' system is described and illustrated in the "Elek. Anz.," April 4; the object is to enable a shunt motor to be uncoupled very quickly without causing trouble due to the spark of the extra current; by means of a peculiar switch, and a magnet on the machine he utilizes the extra current obtained when the circuit is open, to release a mechanical coupler of the shaft.

*Dynamo with Single Bearing.*—A very full table of electrical data of the different sizes of the machine mentioned in the Digest last week, is published in the Lond. "Elec. Eng.," April 12.

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*Ball Dynamo.*—A detailed description of the dynamo and the "improved Ball system of electric arc lighting" is given in the "Elec. Age," April 20.

## LIGHTS AND LIGHTING.

*Illumination.*—A long and well illustrated extract of the recent publication of Mr. Marechal, an illustrated abstract of which was given in the Digest, Aug. 11, 1894, is published in the "Zeit. f. Beleucht," March 15 and 31; the latter number contains diagrams showing the lines of equal illumination (analogous to contour lines in typographical maps) for different dispositions of lights; the article includes estimates of the cost of lighting. The present article is much more complete than the one from which our former abstract was taken; an extract with some of the curves is published in "La Nature," April 6.

*Arc Lamps of Adjustable Candle Power.*—The "Zeit. f. Beleucht.," March 15, gives a description from a German patent of an arc lamp in which the candle power may be adjusted to any desired amount, the device being that of Messrs. Schoeller & Jahr. The adjustment is effected without making any change in the lamp itself; it may be done by means of a resistance shunting the series coil or one in series with the shunt coil or both; this resistance may be placed wherever convenient and at any distance from the lamp; a diagram and a calculation of the required resistances are given.

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*Electric Elevators.*—An editorial in the "Elec. Eng.," April 24, calls attention to the system of charging for electrical elevators taking current from the Edison station, from which 250 elevators are run; a minimum charge is made for each elevator and it is shown that in but a few cases is the charge for actual current consumption smaller than this minimum charge of $3 per month; in Mr. Leonard's recent paper he advocated a very high charge for elevator service on account of the very intermittent nature of the load, but it stated that "experience has abundantly proved to the company that the compensations brought about in a large system of distribution have made groundless the fears on this score."

## POWER AND HEAT.

*Long Distance Transmission.*—According to "L'Elettricista," April 1, the Edison Company of Milan, Italy, will undertake the construction of a large plant to transmit 10,960 hp from the river Adda to Milan, a distance of 31 km. A tunnel 4.50 metres in diameter will be constructed, four groups of turbines and dynamos will be installed.

*Power Installation in Quarries.*—An illustrated description of a very large traveling crane and other electrical machinery used in a quarry in France, is published in "L'Elec.," April 6, including a detailed statement of the first cost and cost of operation.

*Electricity in Agriculture.*—A brief description of a plant in Tarn, in which very satisfactory results were obtained with electrical plowing, is given in "L'Elec.," April 6.

*Thermopile.*—An illustrated description with data, of the latest form of the Guelcher thermopile, is published in the "Zeit. fur. Elek.," April 1; the "total electrical energy" (presumably including that lost in internal resistance) amounts to about 70 watts per cubic metre (35.3 cubic feet) of gas per hour.

*Governing of Steam Engines.*—The Lond. "Elec.," April 12, contains an article by Mr. Addenbrooke on this subject.

## TRACTION.

*Traction.*—The bulletin of the "Soc. des Ing. Civils" for January, contains a paper by Mr. Badois on "The Comparative Efficiencies of Electrical and Compressed Air Traction" in which he criticises the figures in a recent paper by Mr. de Marchena read before that Society (see Digest, Oct. 6, 1894); he differs in that he believes motor cars preferable to locomotives, and believes that the efficiencies for electrical traction were too high and those for compressed air traction much too low, claiming that they do not agree with the results obtained in practice on lines where compressed air traction is used; these results are discussed

in detail; the paper favors compressed air traction. The same bulletin contains a paper by Mr. Regnard forming part of a discussion of the same paper. It also contains a reply by Mr. de Marchena in which he gives detailed data to substantiate the values which he gave.

*Electricity on Steam Roads.*—According to "L'Elec.," April 6, a railway 2.5 miles long near Paris is to have its motive power changed from steam to electricity; this will be the first railway in France in which this change is to be made. There will be two locomotives of 400-hp each, drawing trains of eight and ten cars (presumably like those usually used in France which are not much larger than a large American street railway car); they are to run at a speed up to 90 km (about 54 miles) per hour; contact will be made by means of a central rail placed on the sleepers but in the stations the current will be taken from an overhead conductor; the construction of the road has already been begun and it is believed that it will be finished by autumn.

*Accumulator Traction.*—In a communication to the "Elek. Anz.," March 21, the promoters of the system of accumulator traction with which experiments are being made in Hagen and Vienna, state that the recent articles in which it was claimed that the system was a failure, are mere inventions; it believes that no competent authority will deny that these roads furnish another proof that accumulator traction is quite practical; (the alkaline accumulator is used on these lines).

According to the German journals the construction of an accumulator road from Hagen to Eckesey is about to be begun, and it is expected that the road will be running during the summer; several other similar roads are under consideration.

*Conduit Road.*—A note in the "Elek. Anz.," April 4, states that the firm of Siemens & Halske have for nearly a year been experimenting with the Lachmann system and are now about to construct a longer road; the system is not described, but it is stated that the cost is no greater than that of the overhead system as used in this country.

*Trolleys and Other Collectors.*—The Lond. "Elec. Eng.," April 12, contains a paper by Mr. Smith on "Some Methods of Collecting the Energy in Electric Railways and Tramways," which was read at the Northern Soc. of Elec. Eng.; he treats the subject chronologically, but considers only those devices which have been or are in use; it is not illustrated.

*Mountain Climbing Railways.*—The Lond. "Elec. Eng.," April 12, begins an article by Mr. Scott on this subject; he discusses rack railways and gives some information about existing rates chiefly in Switzerland, in most of which, however, electricity is not used.

*American Electrical Tramway Gearing.*—The Lond. "Elec.," April 12, contains an illustrated paper of Mr. Dallas on this subject.

*Rome.*—According to "L'Elettricista," April 1, a new line of electric tramways will be started in Rome during the present year; the power will be supplied from the Tivoli-Rome alternating current transmission plant by means of a Schuckert rotary converter or dimorphic dynamo, which is a continuous current dynamo having both an ordinary commutator and two collecting rings connected to two opposite points of the armature winding.

*Electric Towing of Canal Boats.*—A description of the system which has been in use for some time on the Bourbogne canal, and which has already been referred to frequently in these columns, is reprinted from the "Ann. des Ponts et Chaussees" (no date) in "Rev. Ind.," March 30; it includes very good illustrations of a number of the details; the current is taken from an overhead line and the traction is accomplished by means of an anchored chain running over pulleys. The accumulators used to equalize the load proved to be of little use; without these the total cost of the system is said to be $4,000 per km; the cost for transporting 1,000 tons by steam in 11.65 hours is stated to be $20.40 and with electricity in 11.01 hours, $14; it has been in use too short a time to draw definite conclusions.

*Electromagnetic Towing of Canal Boats.*—The bulletin of the "Soc. des Ing. Civils" for January contains a long paper by Mr. de Bovet in which he discusses in detail mechanical traction as applied to canal boats, describing briefly some rudder motors and giving a full description together with several plates of illustrations of his system and its application in France, in which an anchored chain is clutched by a magnetic device which was described and illustrated in these columns several years ago.

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*Emergency Brake.*—The "St. Ry. Gaz.," April 20, speaks very highly of the Bonta emergency brake used by the North Hudson County Railway Company; it has been in use for several months and is said to have proved itself thoroughly reliable, most of the cars being equipped with it. It is not described, but it is stated that the energy of the moving car is utilized as a force to prevent the turning of the armature, and the brake is operated by the reversing switch handle, being entirely independent of the usual brake; a quarter of a turn of the lever is all that is required to apply the brake; it is claimed that the strain on the gears is not as great as would be supposed, as the force applied rises gradually from zero to its full power; a car can be stopped on a grade, going at full speed, within less than the car's length.

*Counter-weight System at Providence.*—An illustrated description of the Kuhlmann system is published in the "St. Ry. Rev.," April 15; by means of that system electric cars are drawn up short, steep grades by connecting on to a short cable in a slotted conduit; it is in use at Seattle, Portland and Providence.

*Jungfrau Electric Railway.*—The "St. Ry. Gaz.," April 20, reprints from the London "Graphic" two illustrations of the contemplated electric railway and elevator to the top of one of the highest mountains in Switzerland; (the data concerning this road has already been given in these columns).

*Trolley War in Connecticut.*—Mr. Gager's argument before the committee of the Connecticut legislature, in favor of the street railway companies, is published in full in the "Elec. Rev.," April 24. An article of some length discussing this subject is published in the "St Ry. Rev.," April 15.

*Chicago Elevated Road.*—A brief illustrated description of this road, which was recently opened, is given in the "Elec. Eng.," April 24.

*Chicago.*—An illustrated description of the California avenue power station is given in the "St. Ry. Gaz.," April 20.

*Locomotive.*—A brief illustrated description of the Sprague 67-ton locomotive for handling heavy freight, which was just completed by the Baldwin Locomotive Works, is given in the "Elec. Rev.," April 24.

## INSTALLATIONS, SYSTEMS AND APPLIANCES.

*Electric Light for Railroads.*—The whole of the discussion of Mr. Langdon's paper (see Digest, April 20) is published in the Lond. "Elec.," April 12. A number of the speakers gave data regarding similar installations. Mr. Fletcher referred to a plant run entirely by city gas at 75 cts. in which they produced a current at 5 cts. per kw hour including all charges; the capacity of the plant was 750 incandescent and 36 double carbon arc lamps, and the engine used was an entirely new one built on the tandem principle without any stuffing boxes. Dr. Preller stated that the practice on the Continent was to suspend the arcs 50 to 60 feet above the rails and make them 80 to 100 feet apart, the globes being opalescent and the lamps requiring 10 to 16 amperes. Mr. Langdon stated that as all the machinery must be kept in perfect order there is no possibility of allowing it to depreciate, and hence there should be no item of depreciation except in so far as it may be necessary to replace existing machinery with that of an improved character at some future time, and for this he allows 5 per cent. Mr. Leonard greatly preferred the clear globes when the lamps are placed very high. Mr. Manville spoke very highly in favor of the rectifiers which he had used since they were first introduced and which have proved themselves eminently satisfactory, having also achieved great economy. Mr. Albright condemned high tension direct current series arc lighting on account of the danger; he preferred the multiple arc system and stated that one could now rely on 220-volt incandescent lamps. Mr. Trotter spoke at some length about the question of illumination, and called attention to the question of whether a high maximum or a high minimum illumination is the important thing; he gave the maximum and minimum values of the illumination in foot candles for different arc lamps at different heights and distances; in this kind of lighting the ratio of the distance apart to the height is the important factor; taking Mr. Langdon's figures the lamps were six times as far apart as they were high. Mr. Siemens stated that the height ought to be about two-thirds of the distance between the lamps in order to get the maximum illumination in the centre of the space between the two posts. Mr. Chamen spoke of inverted arc lamps which had been installed in a warehouse to replace incandescent lamps which were unsuited; the result was a considerable economy in current, the amount of energy being about half of that used by the incandescent lights while the lighting was everything that could be desired; the shed measured 350 x 120 feet and the lighting was done with 12 lamps of 10 amperes. Mr. Mordey stated that he was an advocate of direct currents for arcs where they did not want a large amount of other work which could be done better in other ways, but if the arc lighting is a small part it should be done by alternating currents or with rectified alternators; he thought that the argument against alternating current arc lamps, that they did not give as much light, was exploded. Mr. Crompton among other things stated that it was very bad practice to use alternating current in a freight yard.

*Train Lighting.*—Some data regarding the system which has been in use in Germany is given in the "Zeit. f. Beleucht.," March 15; the result is said to be very good financially; it is stated that the cost of electric lighting is only about 50 per cent. of that of gas lighting as formerly used; of the 64 postal cars in use 27 are now provided with this system of electric lighting while the remainder will also be equipped in the course of time

*Best Combination of Electric Light Undertaking.*—The paper of Mr. Dawbarny (see Digest last week) is concluded in the Lond. "Elec. Rev.," April 12. He recommends that each alternator should have its own exciter, that all the alternators are run at a constant pressure and that no adjustment whatever of the exciter fields be made, all the regulation being effected by an impedance coil or augmentator in each feeder circuit. He discusses switchboards, means of obtaining an uninterrupted supply, mains and accessories outside of stations, etc.; for the primary wires he recommends the drawing-in system and for the secondary, steel-armoured concentric cables laid directly in the ground without

further protection. The paper contains a number of practical hints and suggestions.

*Consumers and Charges.*—In a short article by Mr. Barnard in Lond. "Lightning," March 28, on this subject he gives a diagram in which the consumptions by different customers are compared in the following manner: eight consumers are supposed to have used an equal quantity of energy, each of which is represented by a rectangle on cross-section paper, the abscissæ of which give the time of the day when these loads are put on and taken off, while the lengths of the ordinates give the proportion between the amounts of capital necessary to provide the plant, in order to supply these eight consumers with equal quantities on the same day. He favors the Brighton system of charging (see Digest last week) and discusses the difference between it and the ordinary system.

*Charging for Electric Supply.*—In a brief communication by Dr. J. Hopkinson he refers to the recent paper of Mr. Wright (see Digest last week) and states that he considers Mr. Wright's method of applying his (Hopkinson's) principle a decided improvement upon his own; Wright charges a high price until the maximum strength of the current has been used for a certain number of hours and subsequently charges a lower rate; he thus avoids the necessity of asking the consumer by which system he will be charged.

*Cost of Electrical Energy for Private Installations.*—The Lond. "Engineering," April 12, compiles some figures from the recent paper of Mr. Langdon (see Digest, April 20), from the discussion of his paper (see Digest this week), and from the weekly figures published in Lond. "Lightning," with a view to showing when it is more economical to obtain the current from central station or when it is cheaper to generate it on the premises; the conclusions are that there is no very great economy in a private installation even up to 200 or 300-hp; it is the load factor which governs the cost, if the machinery can be kept running for a greater portion of the time than is the case in the average central station then there is the prospect that it can be run cheaply

*Comparative Cost of Light and Power from Private and Central Stations.*—A long article in which this subject is discussed very thoroughly is contained in the first three numbers of the "Maschinen Informator," by Prof. Zickler; he deduces curves which represent the conditions under which the cost is the same.

*Amortization* —The discussion is continued in the "Elek. Zeit.," April 11, by a communication from Dr. Haas and another from Mr. Pruecker.

*Automatic Switch.*—"L'Eclairage Elec.," March 16, gives a well illustrated description of the Hopkinson automatic switch for use in charging a series of accumulators.

*England.*—The Lond. "Elec. Eng.," April 12, publishes two large tables in the form of a supplement giving a list of the central stations in operation in London and the Provinces and another of those in progress, contemplation, etc.; tabular data is given for each station including the cost of installation, the working expenses and receipts; no claim is made that the table is complete. That journal has always contended that central stations should be in the hands of local authorities and not in the hands of companies. No general summary of the conclusions is given.

*Rome.*—The Electric Supply Company of Rome publishes in "L'Elettricista," April 1, an account of the work of the past year; 3,571 metres of underground network were added; the whole length of mains in Rome now amount to about 34 miles exclusive of the transmission from Tivoli. There are now installed 733 arc lamps and 37,828 glow lamps; the equivalent number of 8-cp lamps amounts to 66,812, of which 15,538 were added in 1894.

*Installations in Switzerland and Savoy.*—The bulletin of the "Soc. des Ing. Civils" for January publishes a paper by Mr. Lavezzari in which he describes a number of lighting, power and railway installations.

*Salzunger.*—A description of this accumulator station is published in the "Elek. Anz.," March 21 and 24; it includes two large double page plates showing the ground plan and the complete system of connections.

*Belfast.*—A description of this accumulator station is published in Lond. "Lightning," April 4.

*Ship Lighting Plant.*—An illustrated description with data of a recently installed plant, is given in the Lond. "Elec. Eng.," April 12.

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*Transformer Boxes on Streets.*—The "West. El.," April 27, reprints the illustrations from a German journal showing a transformer chamber as used in the Chemnitz station.

*Varying Cost of Electricity Supply.*—Mr. Wright's article abstracted in the Digest, April 27, is reprinted in "El'ty," April 24.

*Three-phase Plant at St. Hyacinthe.*—A brief description of this plant, which is said to be the first three-phased plant in Canada, is given in the "Elec. Eng.," April 24.

*Baltimore.*—An illustrated description of the new Brush station is given in the "Elec. Eng.," April 24.

## WIRES, WIRING AND CONDUITS.

*Explosions.*—The report of the committee of the Royal Society and the Institution of Electrical Engineers regarding the alkaline deposit in the case of the St. Pancras explosion, is published in full in the Lond. journals, April 12. The committee is of the opinion that the explosion was due to a mixture of coal gas and air ignited by sparks caused by the incrustations which were found; such sparks may be caused either by the incrustation itself acting as an imperfect conductor or by moisture in contact with metallic sodium or potassium, both of which metals were found in the incrustation; these metals were produced by the electrolytic decomposition of alkaline salts derived chiefly from the soil and conveyed by moisture along the fibres of the wooden bearers toward the negative conductor; to avoid a repetition of the accident the bearers of the insulators should be replaced by others through which moisture cannot travel. An analysis of the deposits is given.

*Present Methods of Electric Wiring.*—An article by Mr. Bathurst referring more particularly to conduits vs. casing, is published in Lond. "Lightning," March 28, and is discussed by others in succeeding issues.

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*Practical Wiring Specifications.*—In a short article under this heading in the "Elec. Eng.," April 24, Mr. Dobbs calls attention to the loose form of specifications often met with, and points out the importance of employing experts to draw up the specifications and supervise the work; a few hints are also given.

## ELECTRO-PHYSICS AND MAGNETISM.

*New Electrical Theorem.*—The Lond. "Elec. Rev.," April 12, abstracts a recent Physical Society paper by Mr. Blakesley, vol. 13, part 1st, p. 65. "If in any system of conductors, however reticulated, two or more modes of disposition of source of E. M. F. produce in every part of the same network the same current, such systems of disposition are called equivalent systems. Then the theorem is as follows: If any system of conductors, possessing seats of E. M. F. at any number of points, and if any of these sources be supposed to move continuously along the various bars of the conducting system, and where a point of juncture is encountered, each to become a seat of the same E. M. F. in each of the newly encountered bars (of course, leaving the resistance of the source behind), then the disposition at any moment is equivalent to that at any other moment, and, therefore, to the original disposition. (Of course, the direction of the E. M. F. must be carefully maintained the same; if it is towards the knot before crossing it, it must be away from the knot after passing it.)" Equivalent systems might have been defined as those which produce the same expenditure of power in each part. Several propositions which follow from the theorem are given.

*Dielectric Hysteresis.*—A Royal Society paper by Messrs. Porter and Morris is reprinted with illustrations in the Lond. "Elec.," April 12. They describe experiments to ascertain whether the additional dissipation which was found when a condenser discharged itself through a coil containing induction, is the result of viscosity only or true hysteresis; they claim that a sharp distinction should be made between the two, viscosity being a time effect while hysteresis does not in any way involve the rate at which the changes in the quantities are made; the results are given in tables and curves and the method used is described; the results show that while the condenser, in which paraffined paper was used, exhibits marked viscous effects, yet they could detect no hysteresis.

*Dielectrics.*—The paper of Mr. Appleyard (see Digest, Oct. 27) is published in full in the Lond. "Proc. Phys. Soc." for January.

*Conduction of Heat and Temperature in Geissler Tubes.*—A paper by Mr. Warburg from the "Weid. Ann.," 54, p. 265, is abstracted in the Lond. "Proc. Phys. Soc." for April. Among other things he states that since a rise of temperature of several hundred degrees has no effect on the brightness with which the tube glows he concludes that the glow is a direct effect of the current and is not due to the temperature.

*Theory of Electrical and Optical Phenomena in Connection with Movable Bodies.*—A mathematical essay by Mr. Lorentz is abstracted at some length in the Lond. "Proc. Phys. Soc." for March and April.

*Saturation Pressure of a Vapor in an Electric Field.*—A paper by Mr. Sokolow from "Jour. de Phys.," 4, p. 53, is abstracted in the Lond. "Proc. Phys. Soc." for April.

*Nature of Maxwell's Displacement Current.*—A paper by Mr. Vaschy from the "Comptes-Rendus," 120, p. 255, is abstracted in the Lond. "Proc. Phys. Soc." for April.

*Electrostatics* —Mr. Pellat's article mentioned in the Digest, March 23, is continued in "L'Eclairage Elec.," March 16.

*Action of Cathode Rays on Salts.*—A paper by Mr. Goldstein from the "Weid. Ann.," 54, p. 371, is abstracted in the Lond. "Proc. Phys. Soc." for April.

*Luminescence of Glass Due to Cathode Rays.*—The paper of Mr. Burke abstracted in the Digest, Jan. 26, is published in full in the Lond. "Proc. Phys. Soc." for April.

*Magnetic Circuits.*—In an article in "L'Elettricista," April 1, Mr. Giorgi lays stress on the practical utility and the scientific character of magnetic circuits; he points out the principal differences existing between the laws of propagation of heat, according to Fourier's theory, and the laws of magnetization; he shows that there is no advantage in applying the same methods of calculation used for thermal problems, to

magnetic circuits as was suggested by Prof. Ascoli; this question is discussed at some length.

*Magnetic Shielding by Hollow Iron Cylinder.*—Prof. Perry's paper mentioned in the Digest, Oct. 20, is published in the Lond. "Proc. Phys. Soc." for February.

*Magnetic Shielding.*—A paper by Mr. Ascoli from the "Weid. Ann.," 54, p. 381, is abstracted in the Lond. "Proc. Phys. Soc." for April.

*Mirrors of Magnetism.*—The paper of Mr. Thompson and Mr. Walker abstracted in the Digest, Feb. 23 (see also March 2, 1894), is published in full in the Lond. "Proc. Phys. Soc." for April.

*Electromagnetic Rotation of Solutions of Hydrochloric Acid.*—A paper by Mr. Schoenrock from the "Zeit. Phys. Chem.," 16, p. 29, is abstracted, including a table of results, in Lond. "Proc. Phys. Soc." for April.

*Automatic Air Pump.*—An article by Mr. Kiss describing the Schuller pump is abstracted in the Lond. "Proc. Phys. Soc." for April; he combines a water and mercury pump to form an automatic apparatus.

*Abstracts of Physical Papers.*—Beginning with the issue of January, 1895, the Lond. "Proc. Phys. Soc." contains a large number of abstracts of physical papers from foreign sources among which are quite a number on electricity; many of them are of not very recent date; most of them have been noticed in the Digest; beginning with the April number of these Proceedings, those abstracts which have not been noticed in the Digest will be referred to in these columns.

## ELECTRO-CHEMISTRY AND BATTERIES.

*Thermo-Chemical Carbon Cell.*—The Lond. "Elec.," April 12, calls attention to a recent French Academy paper by Mr. Korda on this subject. He finds that if barium peroxide is heated to redness in contact with a carbon plate it becomes reduced to baryta producing a difference of potential of about one volt, the carbon plate being negative. A similar result was obtained with cupric oxide when a layer of potassium carbonate was placed between the oxide and the carbon, the difference of potential being 1.1 volts; the experiments were made by placing the salt on a plate of gas-retort carbon and dipping the platinum wire into it; when heated to a dull red carbon dioxide is evolved causing violent effervescence. A longer abstract is published in the "Rev. Ind.," April 6, in which it is also stated that the electrical energy accompanying the reaction represents but a small fraction of the chemical energy developed most of which is transformed into heat; if, however, graphite is used instead of artificial carbon, the voltage will remain the same and the quantity of copper and peroxide formed bears a better relation to the weak current produced; in any case the law of Faraday does not apply on account of the heat energy which is present in reaction.

*Borchers' Battery.*—In the "Zeit. f. Electrochem.," April 5, Dr. Borchers reprints the recent article of Messrs. Barnes and Veeseneyer (see Digest, Feb. 23), and replies to it. He grants that those experiments may have been made with great care but he claims that they have gone too far in the deductions; he states that a fundamental condition for the generation of current by a chemical process is "the separation of the material of the annode from the substance which oxidizes or dissolves it," referring to a recent paper by Dr. Ostwald; as the experimenters stated that there was a diffusion of the oxidized liquid through the porous cell to the annode, he states that such a cell could not have given the expected result; if it can be shown that copper solutions have this property with all porous diaphragms, then it would only prove that any apparatus with a porous diaphragm would not be suitable for such a cell and the apparatus proposed but not yet tried by him would then require to be modified; but these experimenters have not proved this for they have not tried different diaphragms; a proof to the contrary was shown by Mr. Tatlow (see Digest, Feb 9); there appear to exist, therefore, diaphragms which are capable of keeping cupric and cuprous solutions separated from each other. He denies that these experimenters adhered to the conditions given by him. In conclusion he states that as soon as he has time he will work out and publish the "complete chemical balance sheet" called for by the Lond. "Elec."; until then he declines to discuss the subject further.

*Improv ment in the Callaud Cell.*—The "Zeit. f. Electrochem.," April 6, contains an article by Mr. Bolton in which he describes an improvement which he has recently tested. An important objection to the present form is that the copper sulphate is apt to come in contact with the zinc occasioning a loss in both substances; to overcome this he mixes one of the solutions with a sufficient amount of gelatine and allows it to set; the diffusion while at rest, from the gelatinized solution to the other and the reverse, is approximately the same as with the simple solutions, but the diffusion will in no way be affected by mechanically shaking the battery, and such a cell therefore becomes transportable. He describes a number of tests made with the ordinary cell, with another in which the copper sulphate was gelatinized and with another in which the zinc sulphate was gelatinized; the results of the tests covering 12 days are given in detail; in order to prevent diffusion some zinc shavings were laid on the top surface of the gelatinized copper sulphate; although the zinc in the ordinary cell was soon covered with the usual copper deposit, that in the gelatinized cells remained quite clean; the internal resistance of the gelatined cells was increased only 12.5 per cent., which in a week was reduced to 10.2 per cent.; that in which the zinc solution was gelatinized gave better results than the one in which the copper solution was so treated; in the former a plain solution of zinc sulphate was poured over the gelatinized zinc solution. It is claimed that this is much better than to use paper, sawdust, or other separators, as it is much cleaner and there is no copper deposited, while at the same time it is transparent.

*Accumulator.*—The "Zeit. f. Electrochem.," April 5, gives a brief description of the Riguelle accumulator from the English patent; the spongy lead is replaced by a spongy mass of an alloy having the formula three atoms of lead and one of tin; if the useful voltage of the ordinary lead accumulator is taken as 1.97 that of the present form will be 2.25.

*Purification of Edible and Lubricating Oils by Means of Electricity.*—The "Elec. Tech.," March 15, states that Mr. Levatt, of Paris, made the following experiments: A cylinder was filled with olive oil of a poor quality, sour taste and brown color, and enough water was added to make a layer 1 to 1½ in. deep; two electrodes connected with a dynamo were inserted in this water and a current at two or three volts was allowed to pass until the water was nearly all decomposed, after which the oil had a bright color, its taste was completely changed, becoming quite pleasant, and the acidity had disappeared; about 20 low-class oils were tried and in all cases were greatly improved; a number of lubricating oils of a poor quality were also tried containing at least 5 per cent. or more acid which was reduced to 1 per cent. and by a repetition of the process down to $\frac{1}{10}$ per cent., but the remaining acid could not be extracted by any means; no further details are given.

*Purification and Sterilization of Drinking Water by Electrolysis.*—A paper by Mr. Oppermann is abstracted briefly in the Lond. "Proc. Phys Soc." for April. In the electrolysis of water small quantities of ozone and hydrogen dioxide are formed; he describes a technical process for preparing drinking water by the use of ozone, the best conditions for the production of which are, a temperature below five or six degrees C., small platinum electrodes and a high current density; an excess of ozone makes the water unfit for drinking; to get rid of the ozone and hydrogen dioxide he proposes to submit it to a second electrolysis with aluminium electrodes; after filtering, the water is fit to drink.

*Metallurgy of Gold.*—A new process invented by Mr. Lossen is described briefly in the "Elek. Anz.," March 28. The solution for dissolving the gold from the finely pulverized ore consists of potassium bromide which has been electrolyzed without a diaphragm, and changed into an alkaline solution of bromium; the ores are treated with this in large revolving drums, sufficient solution being added to keep it alkaline until all the gold is dissolved; other metals contained in the same ore will be changed into insoluble hydro-oxide compounds; after filtering, the gold is deposited by means of iron or coal and the solution is thereby re-converted into bromide of potassium, which is then electrolyzed and used again; the process is to be tried in a mine in Oregon.

*Electrolysis of Gold.*—The discussion of Dr. Keith's recent paper is continued in the form of an article by Mr. Fitzgerald in the Lond. "Elec. Rev.," April 12; it is devoted mainly to quotations from standard works regarding the definition of the term electrolysis.

*Dye Products by Electrolysis.*—The Lond. "Elec. Rev.," April 12, states that naphthazarin and its products may now be prepared electrolytically; to prepare it a hot sulphuric acid solution of 1.1′-dinitronaphthalene is submitted to the action of the current; one kg of the mother substance is dissolved in 20 kg of acid and the temperature carried to 130 degrees C.; a porous diaphragm is used; the cathode is in the hot solution and the annode in the sulphuric acid, a porous diaphragm separating them; a current of 15 amperes per square "diameter" (probably decimeter) is used.

*Soap.*—A process for making sodium or potassium soaps from salts, fats and resins by electricity is described briefly in the "Elek. Anz.," March 31. At the negative electrode the potassium or sodium which is deposited is converted into a compound of these metals with the fatty acids, while at the positive electrode the chlorine combines with the tin of the electrode, forming the chloride which owing to its specific gravity, falls to the bottom of the tank, where it can be collected; the system appears to be that of Mr. Roth.

*Nickle and Cobalt.*—An electrical method for obtaining pure nickle and cobalt, used by Winkle in his experiments to find their atomic weight, is described in the "Zeit. f. Electrochem.," April 5.

*Electrolysis and Polarization of Mixtures of Salts.*—Acording to Buff when a mixture of two salts is electrolyzed there is a fixed ratio between the amounts of each, decomposed by the current, and this ratio is independent of the strength of the current. The Lond. "Elec. Rev.," April 12, abstracts briefly two papers of Mr. Houllevigue, one dated 1890, and the other from the "Ann. de Chim. et de Phys.," 7, 2, p. 351, in which he shows that the deposit varies greatly with the intensity of the current, which is therefore contrary to the results obtained by Buff. The ratio between zinc and copper deposits increases with the current and is a hyperbolic function of the intensity. When mixtures of variable compositions are electrolyzed he finds that the weight of the one more readily electrolyzed increases regularly with the amount in which it is added to the mixture, except when the total amount is very small; the polarization depends on the nature of the constituents even when only

one undergoes electrolysis; he believes that Lippman's law of the polarization of an electrode holds good only for very small currents.

*The Work of Electrolysis.*—The second installment of Mr. Gross' article is published in the "Elektrochem. Zeit." for April.

*Thermo-dynamics of Galvanic Polarization.*—A paper by Messrs. Jahn and Schoenrock from the "Zeit. Phys. Chem.," 16, p. 45, is abstracted in the Lond. "Proc. Phys. Soc." for April.

*Ions.*—The conclusion of Dr. Gerstman's article is given at considerable length in the "Elektrochem. Zeit." for April.

*Cathode Polarization.*—A paper by Mr. Roszkowski from the "Zeit. Phys. Chem.," 15, p. 267, is abstracted in the Lond. "Proc. Phys. Soc." for April.

*Electrolytic Conductivity Curves.*—A paper by Mr. Swarts from the "Zeit. Phys. Chem.," 16, p. 118, is abstracted briefly in the Lond. "Proc. Phys. Soc." for April.

*Progress of Scientific Electro-Chemistry.*—A third installment of Mr. Luther's article is published in the "Zeit. f. Electrochem.," April 5.

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*Electro-Metallurgy of Gold.*—The "Eng. & Min. Jour.," April 20, gives an abstract of the recent litigation and decision in the English court regarding the MacArthur-Forrest patents.

## UNITS, MEASUREMENTS AND INSTRUMENTS.

*Universal Electrodynamometer.*—A small pamphlet published by Springer, Berlin, gives a very complete description of an instrument devised by Prof. Zickler which can be used for measuring current, voltage, and watts, of both direct and alternating currents within no small limits; it consists of an electrodynamometer in which the deflection of the movable coil is balanced by a spring, as usual in such instruments, the deflection being always brought back to zero; the movable coil contains two windings one of fine wire and one of coarse, while the fixed coil is made of quite a number of coils of different sized wire and number of windings; the connections to all of these coils lead to binding posts by means of which they may be conveniently coupled in a number of different ways, thus enabling the instrument to be used as an amperemeter, voltmeter, or wattmeter of adjustable ranges; the data concerning the instrument is given in detail.

*Students' Simple Apparatus for Determining the Mechanical Equivalent of Heat.*—Prof. Ayrton and Mr. Haycraft's paper abstracted in the Digest, Jan. 12, is published in full in the Lond. "Proc. Phys. Soc." for April.

*Clarke Cell when Producing a Current.*—A paper by Prof. Skinner abstracted in the Digest, Oct. 20, is published in full in the Lond. "Proc. Phys. Soc." for February.

*Resistance Material.*—A table of the values of the nickle alloys (mentioned in the Digest last week) is published in "Elek. Anz.," April 4, to which is also added a table for the maximum currents for these wires.

*Measurement of Intensity of Light by Chemical Action.*—A paper by Mr. Lemoine from the "Comptes-Rendus," 120, p. 441, is abstracted briefly in Lond. "Proc. Phys. Soc." for April.

*Determination of Luminous Flux.*—The recent paper of Prof. Blondel from the "Comptes-Rendus," 120, p. 311, is abstracted in Lond. "Proc. Phys. Soc." for April.

*Resistance Determination in Absolute Measure.*—A paper by Prof. Himstedt from the "Weid. Ann.," 54, p. 305, is abstracted in the Lond. "Proc. Phys. Soc." for April.

*Alternating Current Method of Determining the Resistance of Electrolytes.*—A paper by Prof. Kohlrausch from "Zeit. Phys. Chem.," 15, p. 126, is abstracted in the Lond. "Proc. Phys. Soc." for April.

*Determination of Induction Coefficients of Solenoids.*—A paper by Prof. Himstedt from the "Weid. Ann.," 54, p. 335, is abstracted at some length in the Lond. "Proc. Phys. Soc." for April.

## TELEGRAPHY, TELEPHONY AND SIGNALS.

*Reduction of Telephone Rates.*—In a communication to the "Elek. Zeit.," April 11, Mr. Ross disagrees with the opinions recently expressed in that journal (see Digest, April 20), that the reduction in telephone charges can be accomplished only by the use of conversation meters; he argues that, taking the Vienna system as an example, the apparatus is used during only 8 per cent. of the 10-hour day and he believes that in this the difficulty lies; to reduce the cost, the apparatus should be in use during a longer time, and this may be accomplished only by a system similar to that of Mr. Nissl which has already been fully described.

*Telephone Charges.*—In the conclusion of the article on this subject in the "Jour. Teleg.," March 25, a table is given containing the charges in most of the countries of the world except the United States; also those for interurban and international lines.

*Telephone Systems in Large Cities.*—A very long paper by Mr. Wabner is reprinted with the discussion in the "Elek. Zeit.," April 4. He discusses the functions of the central stations and the apparatus, and criticises the propositions which have been made for large stations; he refers more especially to the question of whether it is possible and practical commercially to have one large central station for a large city or whether it would be better to have several central stations with a limited number of subscribers; he thinks the limit for one station should be 5,000 to 6,000 subscribers; in the discussion which follows, differences of opinion were expressed regarding the latter.

*Telephone Switchboards.*—"L'Eclairage Elec.," March 16, contains a well illustrated article by Mr. Vartore in which he refers to the recent article of Mr. Kingsbury and supplements it with an illustrated description of the three principal types of switchboards, which he says "have until now characterized the development of telephony;" they appear to be chiefly of American origin.

*Telephone Service.*—The proceedings of the meeting of the Parliamentary Committee are published in the Lond. "Elec. Rev." and "Elec. Eng.," April 12.

*Long Distance Telephony.*—The "Jour. Teleg.," March 25, begins an article by Mr. Collette.

*Application of the Telephone for Fire Alarm Purposes.*—The "Jour. Teleg.," March 25, abstracts from a report on this subject from the German Government Statistics for 1893.

*Brake Regulator for Synchronous Movement.*—A paper by Dr. Raps describing a new regulator of Siemens & Halske adapted more especially to the Hughes typewriting telegraph, is published in the "Elek. Zeit.," April 11. He gives a short mathematical discussion of the theory and describes the apparatus, which is said to give a very uniform motion and has other advantages; it has been in use for almost a year in Berlin, where it has given very good results.

*Telegraph Statistics for Germany.*—The "Elek. Zeit.," April 4, gives in some detail the statistics for Germany for the year 1893. The length of the telegraph lines was 106,352 km and the length of the circuits 394,552 km; the total number of telegraph stations was 16,902; the total number of telegrams was 30,573,522.

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*Submarine Telegraph Cables.*—The first part of a lecture of a semi-popular nature by Mr. Trott is reprinted in the "Elec. Eng.," April 24; he gives a few details regarding cable laying and repairing from a sailor's point of view, intimating that the sailors as distinguished from the technical engineers are "the men best qualified for this important work."

*Automatic Telephone Exchange.*—The Deckert and Homolka system (which has been in use in Prague for a number of years) is described and illustrated by Mr. Berthold in the "Elec. Rev.," April 24; (a reference to the original description was given in the Digest, Feb. 23).

*Early History of the Telephone.*—The recent remarks of Prof. Hughes referred to in the Digest, April 1, are reprinted in the "Elec. Age," April 20.

*Death from 280 Volts.*—In a communication by Mr. Carr to the "Elec. Eng.," April 24, he states that a fatal accident recently occurred in the mines of the Leavenworth Coal Company in which a laborer was instantly killed while handling a machine the E. M. F. of which did not exceed 280 volts; a number of others received the shock at the same time without injury; he asks for an explanation.

*Biographical.*—A portrait of Coulomb and the titles of seven of his memoirs, are given by Prof. Mayer in the "Elec. Eng.," April 24.

*Opportunities in Electrical Engineering.*—An article by Mr. Atkinson on this subject is begun in "El'ty," April 24; he believes that an electrical career presents to-day as many opportunities as other careers.

## MISCELLANEOUS.

*Calcium Carbide and Acetylene.*—The "Zeit f. Electrochem." contains an article by Dr. Borchers in which he gives the history of these materials stating that in 1891 he published a description of experiments made by himself, from which it follows that there can be no controlling patents for their manufacture, as he then showed that metals containing carbon, that is, metallic carbides, can be produced electrically by heating a mixture of the metallic oxide and powdered coal; (he does not give the reference to his publication). He quotes the recent estimate of Mr. Willson stating that he has no confidence in it, the cost of the electric power being far too low, as also the allowance for labor, etc.; his own experiments show that the amount of power consumed was very much greater; according to his own estimates to produce 1,000 kg of calcium carbide will require 900 to 1,000 kg of burnt lime according to its purity, 800 kg of coal and 450 to 480 electrical hp during the 12 hours. He discusses the various properties and applications of alkaline carbides and acetylene, and states that the latter may be produced by the direct combination of carbon and hydrogen when an arc is formed between two carbons in an atmosphere of hydrogen. An important property of acetylene is that it can be combined directly with nitrogen, forming hydrocyanic acid, by the action of the electric spark.

*Foundations of Electrical Science.*—The Lond. "Elec.," April 12, contains a communication by Mr. Giorgi on this subject in which he criticises some recent statements by Prof. Cornu (see Digest, April 6); he discusses the question of what is the most consistent and logical conception of electrical science; he believes that it is about time that old-fashioned theories should be left out for more scientific ones; he suggests that by assuming the current to be a fundamental conception, the definition of electromagnetic quantities easily follows, electromotive

force for instance may be defined as the coefficient of current in the expression of power, that is the power per unit current. He believes that such a method would be a rational one for the establishment of electrical science.

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*Carbide of Calcium.*—The "Prog. Age," April 15, contains a short paper by Mr Doherty on "Carbide of Calcium" read at the recent meeting of the Ohio Gas Light Association; he gives a brief summary of the subject; he states that even at $100 per ton it might rob the gas man of some business; "it looks very much as though in a very short time it would own the field for car and isolated lighting." This is followed by another paper on the same subject by Mr. Goodwin, giving however very little technical matter; he states that this material may possibly have an influence on the gas business not realized or dreamed of at this time.

*Death from an Electric Shock.*—The "Elec. Rev.," April 24, contains an article by Dr. Bleyer on "Dynamic Apoplexy" in which he claims that the cause of death after receiving a lethal dose of current is due to what he terms dynamic apoplexy, a fact which he ascertained by close investigation. Microscopic specimens of the brain of the criminal Hampton, who was recently executed in New York, are shown, demonstrating the rupture of many blood vessels both in the cerebrum and in the cerebellum, which furnish proofs that point toward the great dynamic power of the current to rupture the blood vessels in these regions, as well as in others such as the liver. He advocates the use of artificial respiration in case of accidental shock.

## New Wood Multipolar Dynamo.

The accompanying illustrations represent a new 60-kw medium speed dynamo for incandescent lighting or power, designed by Mr. James J. Wood, electrician and mechanical engineer for the Fort Wayne Electric Corporation. Fig. 1 shows the complete machine, which, like all of Mr. Wood's apparatus, presents a very attractive and substantial appearance, while the mechanical perfection of detail, workmanship and finish characterize it as a modern high grade machine. In the several sizes up to and including 120 kw, the lower portion of the field, pedestals and base are made in a single casting, while in the larger sizes, which have an outboard bearing, the parts are cast separately and bolted to the base, making the dynamo easier to handle in making installations. A notable feature in this generator is the absence of most of the loose cables, wires and connections so generally used, the connections in this case being made within a closet in the journal pedestal, which is normally closed by a grating. The main terminals are mounted on slate bases at each side of the pedestal, as shown in the cut. The two small binding posts shown in front are for the field rheostat connections. The dynamo is compound wound and can be run in either direction by simply changing the brush holders on the studs without changing any of the connections, the brush holders being so proportioned with relation to the commutator that the act of reversing them on the stud changes the point of contact 90 degrees, placing them in the correct position for commutation when the dynamo is run in the opposite direction. The curved pedestal on the commutator end is also a decided advantage, as it not only reduces the floor space and weight of metal required in the base, but allows the dynamo to be turned end for end on the sub-base if desired. The bearings are self-oiling and aligning, and are of ample proportion to withstand the strains to which they are subjected. The field coils are wound on steel spools with brass heads, making them very easy to replace in case of an accident.

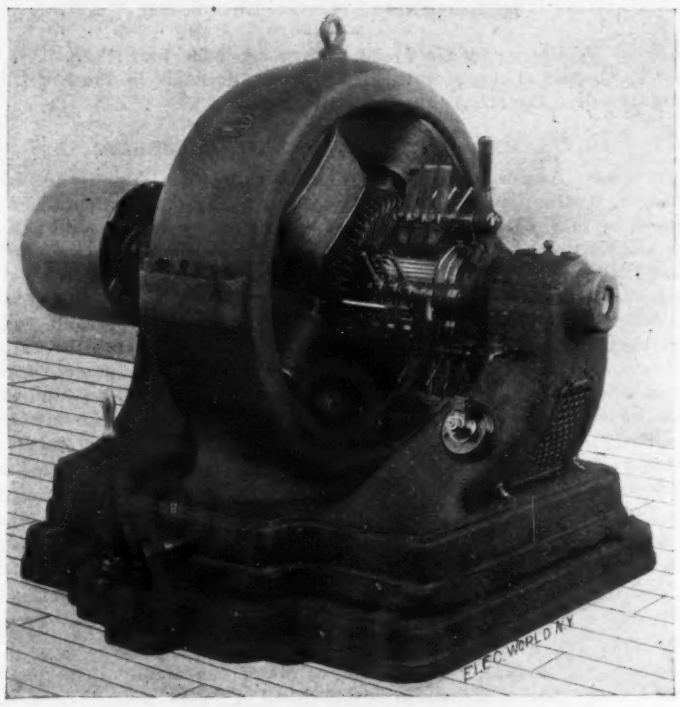



Fig. 1.—Wood Generator.

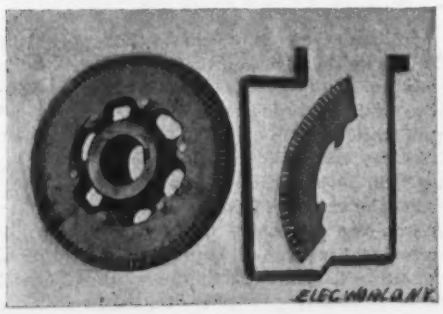



Fig. 2.—Armature Details.

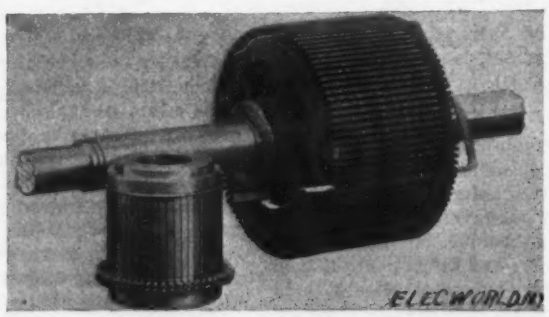



Fig. 3.—Armature Core and Commutator.

The armature construction of this machine embodies several novel features. Fig. 2 shows the commutator and complete core with one of the coils in place, and Fig. 3 shows one of the armature punchings, the method of building up the core, and one of the coils before being insulated. As will be seen from the cut, the armature core is built up of segmental punchings, having hooks projecting from the inner edge, which partly enclose the clamping bolts. These punchings alternate with one another in order to break joints, the hooks making contact with the bolts on opposite sides, but without completing the magnetic circuit around them. This construction renders the several segments self-supporting, there being no strain on the spider or bolts other than that produced by the torque, and as a consequence the spider can be of exceedingly small cross section and in marked contrast to the heavy cast iron or steel structure usually required. The hooks which engage with the clamping bolts not only break joints but alternate in position leaving spaces between the adjacent segments equal to the thickness of the iron punchings, which gives a very great increase in the radiating surface of the core.

A careful set of tests are said to have shown that with this construction there is absolutely no current generated in the clamping bolts or spiders. The advantages claimed may be summed up as follows: Minimum weight of armature; greatly increased radiating surface; self-supporting core construction; simplicity of spider construction; economical use of sheet iron, and small cost for punching dies and their maintenance. This method is particularly advantageous in the construction of armatures of large diameter.

The armature coils present features of rather greater simplicity than the bar method of winding heretofore employed and embodies decided electrical and mechanical advantages.

The coil is composed of four bare wires, wound on a former, with a heavy copper connector soldered at one end, which makes connections by screws to the commutator segments. This construction obviates joints at each corner of the winding, and reduces the number of soldered joints form five to one, as compared with the bar method. As a consequence the resistance of a turn and the $C^2R$ losses in the armature are materially reduced. After being formed in shape, shown in Fig. 3, the coil is carefully insulated and placed in position on the core, as shown in Fig. 2, the return ends being soldered into holes in the commutator connector referred to. The commutator is then slipped on the shaft and each connection secured to its proper segment by two screws.

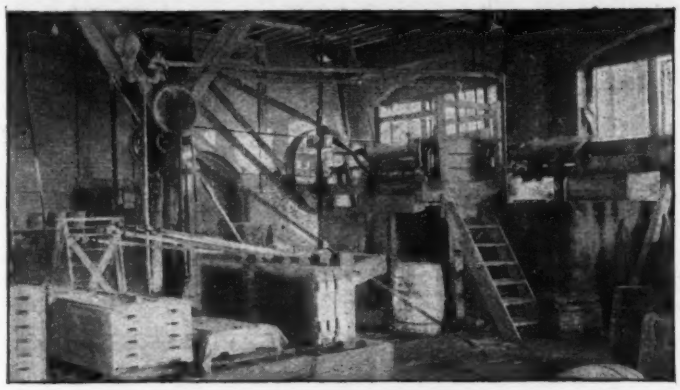
The commutator is constructed of hard drawn copper with mica insulation, and put together by hydraulic pressure. The commutator segments, brushes and brush holders are of ample cross section for the currents which the dynamo is intended to generate. The armature circuits are so arranged and connected that either two or four sets of brushes can be used on the commutator; either set can be removed while the dynamo is running, and the remaining set will carry the current without over-heating. On a recent test a 60-kw dynamo was run on a load of 525 amperes at 120 volts for 10 hours, after which careful readings were taken, and the result showed the maximum rise in temperature in any part of the machine to be only 35 degrees C. above that of the room.

The dynamo weighs complete 7,300 pounds, while the armature complete weighs but 950 pounds, and at a speed of 650 revolutions per minute delivers 500 amperes at 120 volts, which can be raised to 140 if required.

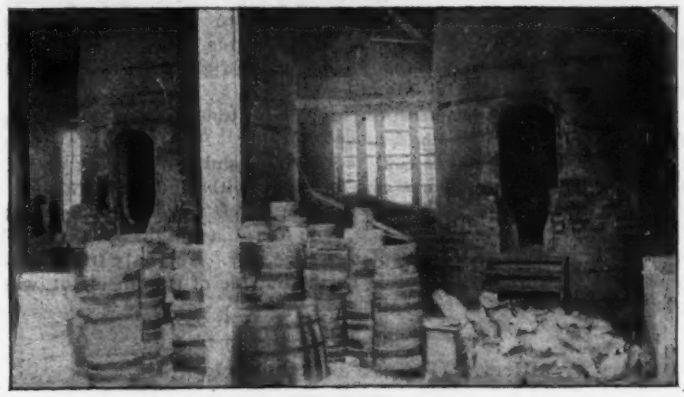
## An Electrical Porcelain Factory.

Owing to the difficulty experienced in obtaining in very great quantity porcelain possessing the requisite character for electrical work, the General Electric Company established some time ago a very complete porcelain factory as an integral part of its immense plant at Schenectady, and this has been in constant operation ever since with excellent results.

This porcelain factory, although only a pottery in miniature, is nevertheless complete as to details, comprising kilns, mixing, moulding, and drying rooms, and a full equipment of the latest and most approved machinery.



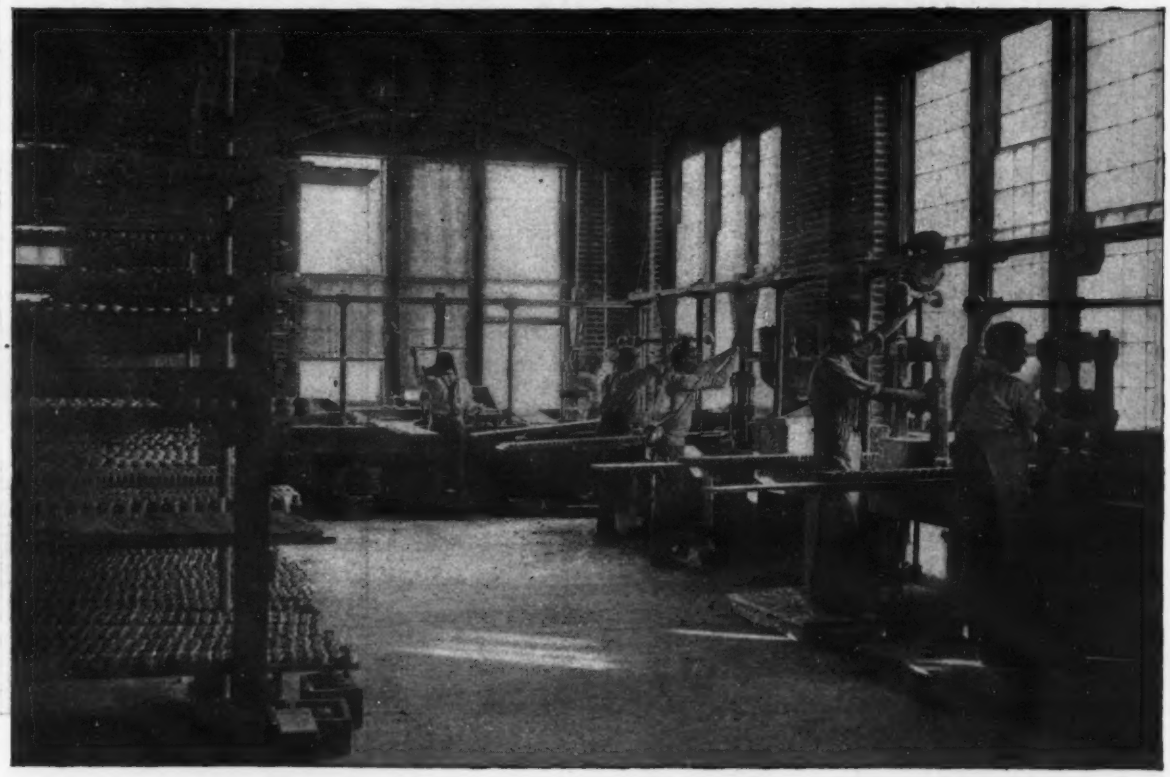
MIXING ROOM.



VIEW OF KILNS.

The building is a two-story brick structure covering an area of about 14,000 square feet. On entering by the main door one is admitted immediately to the mixing room where crude kaolin, or china clay is brought to be washed, manipulated and mixed. After passing through the mixing machine, the clay is strained through bags to remove any hard material which might interfere with the succeeding operations. From the straining press it comes in large lumps, and in that condition is partly dried, placed in a pulverizer and reduced to the necessary condition for use in the press room, to which it is taken in the shape of moist, grayish, disintegrated clay.

The pressing room is immediately over the mixing room. The machines in which the porcelain is moulded are upright screw presses and stand along three sides of the room directly under large windows. The moulds used are made of special tool steel by a corps of experienced tool makers in the works. In designing these moulds, or dies, the shrinkage of the porcelain due to the drying and pressing is calculated to a nicety, in order that when the porcelain leaves the kilns in its finished state, the metal pieces, which have been punched out in the stamping department, may fit accurately. The catalogue number of each piece of porcelain is cut in the die, so that the number appears in relief on the base of the finished piece. The lower part of the die is fixed to a small table, which can be moved up or down by means of a foot lever and sets in a hollow space in a larger table forming the base of the press. The upper part of the mould is fitted to a sliding bar, which is elevated or depressed by a lever and screw. When the die is fixed in position, the pressman weighs out the proper quantity of pulverized clay to be used. With a small brush the two dies are then thoroughly dampened. The bottom one is then lowered to its normal position, and the operator pours in the clay and presses it down evenly with his hands to give it a preliminary packing. A vigorous twist given to the lever brings the upper die down upon the clay with considerable pressure; another twist in the opposite direction raises the upper mould, and at the same time the lower one is elevated by the foot lever. A depression of the latter then lowers the bottom die, and leaves the mass of clay, pressed into the desired form, in the hands of the workman. This is laid with others upon a rack to undergo the process of air drying. The entire space in the centre of the press room as well as a part of the second floor in the main building is occupied by these racks.



PARTIAL VIEW OF PRESS ROOM.

The door in the press room opens into a spacious room which occupies part of the second floor at the left wing and the whole of the main building. In this room all the pieces are touched up; the burrs are removed from all holes through which screws and punchings are to pass; the marks of the dies are cut off and the pieces put into final condition for baking and sent to the kilns.

Descending from the finishing room, the kiln room on the ground-floor is reached, where are to be found four pottery kilns constructed after the latest approved methods. Around the kiln stands piles of yellow "billers" and "saggers" which are made in one corner of the

kiln room. These are filled with the moulded pieces of clay, covered and hermetically sealed. The kiln is then filled with them and the doors closed.

After the first baking the porcelain comes out in the form of a hard, white, compact "biscuit." For certain insulating purposes, this "biscuit" is employed as it comes from the kilns. It is non-absorbent to a high degree, and is used for socket bases and other purposes where the porcelain is not exposed. For switch bases, insulators, cut-outs, etc., however, the porcelain is glazed, and subjected to another firing. When it leaves the firing kiln it is beautifully white, compact in texture, extremely hard, and has exceedingly high insulating properties.

From the kilns the porcelain which is to be used in cut-outs, switches, sockets, transformer connecting boards, and in many other appliances, is taken to the second story of the right wing of the building, where the metal parts are attached.

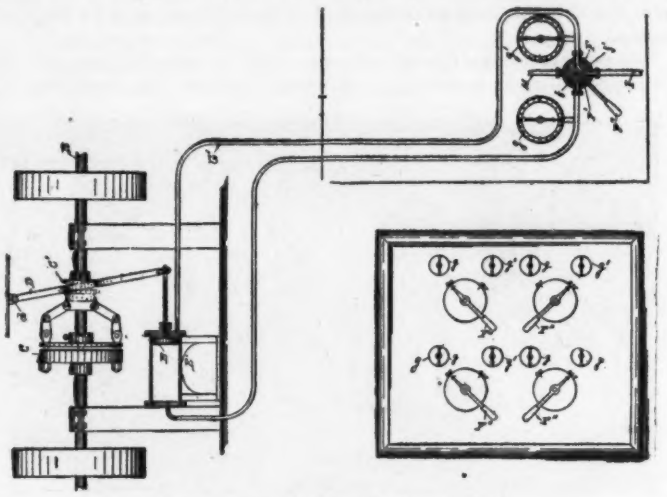
The insulators for special work, such as for transmission at very high voltages, are tested in a small room adjoining. Each insulator is subjected to as severe a test as could be devised, and before being accepted as satisfactory must show a capability of withstanding a pressure of 25,000 volts alternating current. In order to test the endurance of these insulators, the testing current has been raised as high as 52,000 volts before any of these special insulators gave way. The only trace of the enormous pressure then apparent on the outside of the insulator was a pin point hole scarcely perceptible.

## Electric Towels and Underclothing.

A person (or persons), says the London *Electrical Review*, under the style of the Anti-rheumatic Towel Company, is endeavoring down at Manchester to exploit the ailments of valetudinarians and other weak-minded and feeble-bodied humans, by advising them to purchase electric towels and electric underclothing. An extract which speaks for itself, and taken from one of the circulars, is as follows: "The anti-rheumatic towel is made from a fibre which generates electricity on any part of the human body by friction. Cotton and linen produce it similarly, and woollen is more powerful than either; but these and all other known fibres absorb what they produce. The anti-rheumatic towel, having a negative power, compels the body, or part on which it operates, to absorb the electricity it generates. The work there begun by the towel can be carried on by wearing underclothing made from the same fibre. The slight friction caused by the movement of the limbs continues, by a gentle process, to permeate the system with electricity, and invigorates the blood to a lively circulation. Thus the body is strengthened, and the healthful glow which results is a permanent resistant against change of temperature." The confiding public is then assured that a cure in a natural way "is effected if the towel is applied freely to the parts affected, and if this treatment is followed up by the wearing of electric knee-caps, cuffs, waist-belts, chest protectors, vests, pants, combinations, etc.," which seems rather a lot of clothes to wear all at once.

## An Hydraulic Clutch Operating Device.

In the operation by hand of friction clutches considerable effort is required on the part of the attendant, and a great deal of running about is necessitated between the points where the clutches are operated and the switchboard, etc., and it is of the greatest advantage to be able to control the operation of these clutches from the point where the general control of the station is centred, namely, the switchboard. By the use of the system here described, which is an invention of Mr. J. Brodie Smith, of Manchester, N. H., it is possible by the simple turning of suitable valves to control the operation of any number of clutches or other power transmitting devices from the switchboard or other central point, irrespective of the distance at which are located the different devices controlled.



Hydraulic Clutch Controller.

The action of this device will be understood from an inspection of the accompanying cut, from which it will appear that each clutch is provided with a double-acting hydraulic cylinder connected with the lever. This cylinder is connected to a source of hydraulic pressure and to the operating point by means of piping, and situated at the operating point is a four-way valve, suitably arranged to provide for the turning on of the pressure to either end of the hydraulic cylinder or of cutting off the pressure altogether. In one of the positions of this four-way valve the hydraulic pressure acts upon the piston so as to throw the clutch in; in the reverse position of the valve, the pressure acts oppositely on the piston, and throws the clutch out. By a careful manipulation of the valve the clutch may be thrown in and the load "picked up" very

Partial View of Assembly Room.

gradually. In connection with the hydraulic cylinder may be electrical contacts so arranged as to indicate at the controlling point the position of the clutch—whether in or out, and pressure gauges are provided corresponding to each clutch, showing in which direction the clutch is being moved, how fast it is moving, and whether or not it has reached the end of its travel.

It is obvious that there is hardly any reasonable limit to the number of clutches which can be handled from a given point, and a controlling board for four clutches is shown in the lower left hand corner of the illustration.

The character of this device would seem to be such as to appeal with great force to the practical central station man who has tried to accomplish the somewhat difficult task of being in two places at once—at the clutch lever and at the regulating rheostat—and it is believed that this arrangement is capable of extensive application throughout installations employing this method of transmitting power to or from electrical machinery.

## An Efficient Oil Engine.

Oil engines are now being extensively used in Europe, and have proved very successful and economical there for isolated electric lighting plants and other purposes. As this fact is rapidly being recognized in this country a description of the oil engine built by Priestman & Co., Philadelphia, Pa., will be of interest.

This engine is shown in Fig. 1. It is operated by the ignition of a fine oil spray which is drawn into the cylinder of the engine behind the piston in quantities varying in proportion to the load being driven. By varying the spray of oil excellent regulation is obtained without the necessity of suppressing expansions, and the uniform speed thus obtained has secured for the engine an excellent record in incandescent work. In this connection an inspection of the indicator card shown in Fig. 2 will be interesting.

In many respects the engine is similar in its mode of working to gas and other forms of internal combustion engines, but there are essential differences to be considered, one of the most important of which consists in the use of high fire test safety oil (150 degrees). The oil is not carburized, and then used as a gas, however, but is broken up into a fine spray by a special device, and passes into the mixer (which corresponds somewhat to the steam chest of a steam engine and is shown directly below the back end of the cylinder) where it is kept warm by the exhaust passing around it. It is thence drawn into the cylinder and there ignited by means of an electric spark, which is caused to pass between two platinum points just as the piston passes the centre.

The Priestman engine is especially adapted for long runs. As will be seen from the illustration it is modelled after the design of the Straight Line steam engine, provided with centrally hung fly wheels, ample bearings, and a lubricating system designed for continuous feeding through extended periods of service. The piston requires no lubrication, as it works constantly in an oily atmosphere. The engine occupies comparatively little space and its working parts are few and easily accessible. It is built with a solid bed plate, and is self-contained, requiring a minimum amount of foundation work.

One of these engines has recently been placed in the basement of the rectory of a church in a suburban district, where it is employed for driving a deep well pump and a dynamo which furnishes current to operate an electric motor, working the bellows of the church organ. The dynamo also furnishes current for lights at the rectory as well as a small motor and pump combination at a neighboring house. The engine is started by a member of the rector's household, and is left for hours together without any attention. This can be safely done for the reason that the exhaustion of the supply of oil simply causes the engine to stop, and entails no danger whatsoever. There is no extra insurance incurred, which is due to the use of high test oil.

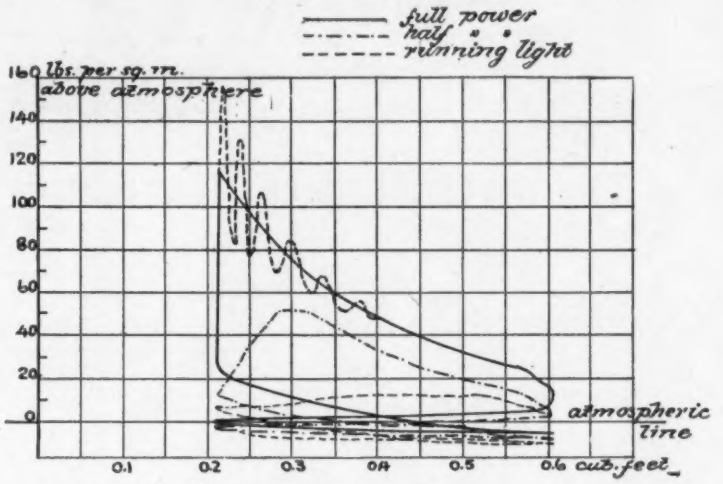



FIG. 2.— INDICATOR CARDS.

The Franklin Institute has recently awarded the John Scott Legacy prize and medal to the inventors of the Priestman engine in recognition of its merits.

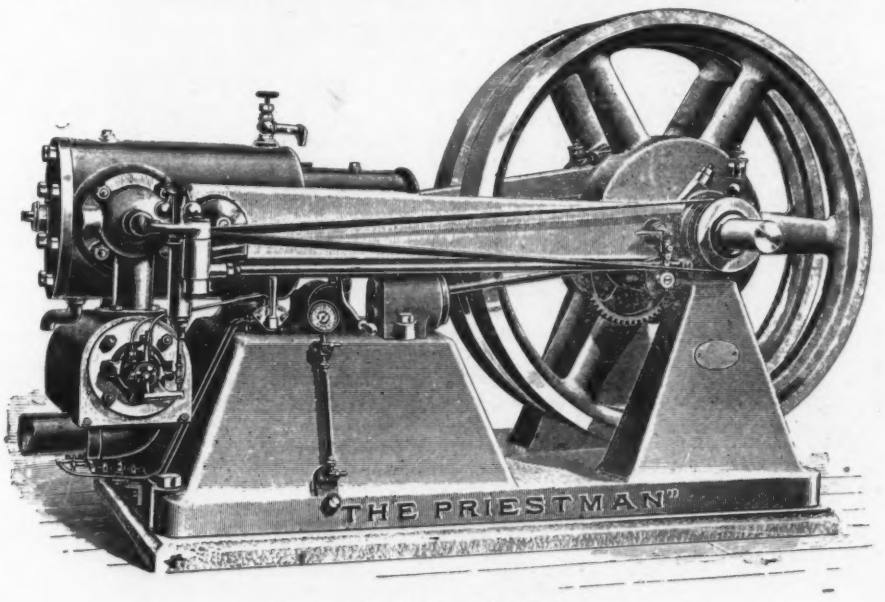
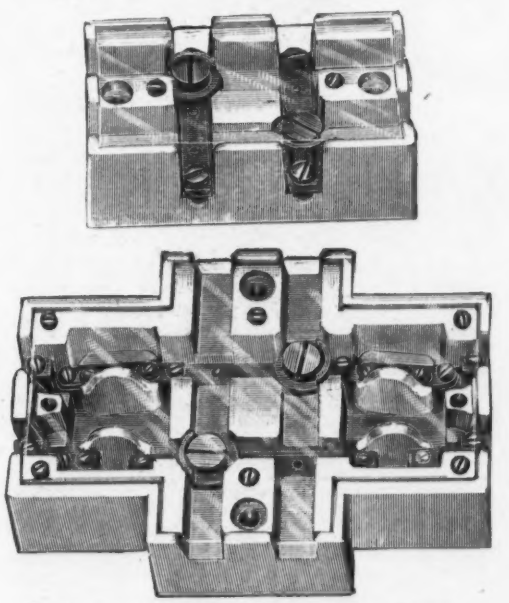



FIG. 1.—IMPROVED OIL ENGINE.

## New Cut-Outs.

A new line of cut-outs has recently been placed on the market by Edward J. McEvoy, 157 Cedar street, New York, late electrical constructor of the William Cramp & Sons Ship and Engine Building Company, of Philadelphia. The connecting bars are made from metal of the best conductivity, and run from end to end in grooves at right angles with the main wire grooves, which are separated by a solid wall of porcelain, thereby making it impossible for a short circuit to occur. The binding screws for the main connections are unusually stout. The branch connections are made by inserting the wires in a solid piece of metal, through which a set screw penetrates, thereby making a secure and efficient contact. Between the main and the branch connections is a receptacle in which a porcelain fuse cup is inserted. The replacing of the fuse entails no further labor than is involved in the loosening of two screws, and detaching the fuse cup, which can readily be replaced without the slightest danger of short circuiting or arcing. Particular attention is paid throughout to the constructions of these appliances in order that absolute reliance may be placed in them. The larger sizes are specially adapted for large feeders, taking a 3-0 or 4-0 wire easily. The medium sizes are the same type, and the smallest is a fuseless branch block mostly used in marine construction, and is now being employed on the St. Louis and St. Paul of the American Line of ships being constructed at Cramp's ship yard.



SINGLE AND DOUBLE BRANCH CUT-OUTS.

# NEWS OF THE WEEK

## Financial Intelligence.

### THE ELECTRICAL STOCK MARKET.

NEW YORK, April 27 1895.

THE ELECTRICAL STOCK LIST maintained a pretty steady front this week, and most of the uncertainty caused by the announcement of the Standard Telephone Company's organization and by the reports concerning the General Electric-Westinghouse deal, has been either dispelled or lulled by the lack of development in both directions.

AMERICAN BELL rallied early in the week from last Saturday's closing to 183, and did not at any time lose any of its first advance. Competent judges of the situation express the belief that the Bell Company will gain at least 60,000 telephones this year, but as there is no reason to believe in a maintenance of old rentals the gain in the output may mean comparatively little financially. Friends of the Bell interests base their sanguine views upon the Bell Company's prosperity in Canada, where the telephone patents have been free for several years.

THE WESTINGHOUSE AND GENERAL ELECTRIC fiasco is explained, by those claiming to be posted, as being due to the fact that the first consultation between the General Electric's committee and its own executives developed "fundamental objections to negotiations on the outline proposed." As a consequence the G E. committee had no meeting with the Westinghouse committee, but reported the facts back to the General Electric board, and asked to be discharged. No subsequent action has been taken, so far as it is possible to learn.

| ELECTRICAL STOCKS. | Par. | Bid. | Asked |
|---|---|---|---|
| Chicago Edison Company | 100 | 120 | 125 |
| Edison Electric Ill., New York | 100 | 97¼ | 98⅛ |
| " " " Brooklyn | 100 | .. | 108 |
| " " " Boston | 100 | 124 | 125 |
| " " " Philadelphia | 100 | .. | 115 |
| Edison Ore Milling | 100 | 13 | 15 |
| Electric Storage Co., Philadelphia | 100 | 28 | 29 |
| General Electric | 100 | 33⅛ | 33¾ |
| General Electric, pref | 100 | 63¾ | 64¼ |
| Westinghouse Consolidated, com | 50 | 34 | 35 |
| " " pref | 50 | .. | 52 |
| **BONDS.** | | | |
| Edison Electric Ill., New York | 100 | 105½ | 105⅝ |
| Edison Electric Light of Europe | 100 | 75 | 85 |
| General Electric Co. deb. 5s | 100 | .. | 90¼ |
| **TELEGRAPH AND TELEPHONE.** | | | |
| American Bell Telephone | 100 | 183 | 184 |
| American District Telegraph | 100 | 30 | 40 |
| American Telegraph & Cable | 100 | 91 | .. |
| Central & South American Telegraph | 100 | 117 | 120 |
| Commercial Cables | 100 | 141 | .. |
| Erie Telephone | 100 | 53 | 53½ |
| Gold & Stock Telegraph | 100 | 105 | .. |
| New England Telephone | 100 | 67 | 68 |
| New York & New Jersey Telephone | 100 | 103 | 105 |
| Postal Telegraph-Cable | 100 | 63½ | .. |
| Western Union Telegraph | 100 | 89 | 89¼ |
| **ELECTRIC TRACTION STOCKS.** | | | |
| Baltimore Traction | 25 | 16⅝ | 16⅞ |
| Binghamton RR. com | 100 | 100 | .. |
| Brooklyn Traction | 100 | 9 | 11 |
| " " pref | 100 | .. | 53 |
| Buffalo St. Ry | 100 | 66 | 69 |
| Cleveland City Ry | 100 | 68 | 70 |
| Cleveland Electric Ry | 100 | 59 | 60 |
| Chicago City Ry | 100 | 305 | 315 |
| Columbus St. Ry | 100 | 46 | 49 |
| Consolidated Traction of N. J | .. | 30 | 33 |
| Electric Traction, Philadelphia | 50 | 71 | 71½ |
| Long Island Traction | 100 | 9 | 9¼ |
| Louisville St. Ry. com | 100 | 37 | 39 |
| " " " pref | 100 | 87 | 88 |
| Metropolitan Traction, Philadelphia | 100 | 89½ | 90 |
| New Orleans Traction | 100 | 15 | 18 |
| " pref | 100 | 56 | 60 |
| North Shore Traction | 100 | .. | .. |
| " " pref | 100 | 74 | 83 |
| People's Traction $30 pd | 25 | 58⅛ | 59 |
| ‡Philadelphia Traction | 50 | 81⅞ | 82 |
| Rochester St. Ry | .. | 38 | .. |
| Union Ry. (Huckleberry) | 100 | 112 | 115 |
| West End, Boston | 100 | 64¾ | 65 |
| " " pref | 100 | 88 | .. |
| Worcester Traction | 100 | 13 | 16 |
| " " pref | 100 | 81 | 85 |
| **BONDS.** | | | |
| Buffalo St. Ry. 1st con. 5s | 100 | 101 | .. |
| *Binghamton Railroad Co. 5s | 100 | 99 | 100 |
| *Columbus St. Ry. 1st 5s | 100 | 9 | .. |
| Rochester St. Ry. 1st. 5s | 100 | 95 | 97 |
| *Union Ry. 1st. mtge 6s | 100 | 105 | 108 |
| *Westchester Electric 1st. mtge. 5s | 100 | 98 | 101 |

* With accrued interest.

‡ Ex-rights.

## Special Correspondence.

### NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD.
253 BROADWAY, NEW YORK, April 29, 1895.

THE OAKMAN ELECTRIC COMPANY, 136 Liberty street, has assigned, with Wm. D. Murray as trustee.

WATKINS GLEN will be lighted electrically this year, and there can be no doubt as to the magnificent results provided the lights be judiciously located and arranged.

MR. MAURICE W. THOMAS, president of the Mason Telephone Company, of Richmond, Va., is in the city with his wife. Mr and Mrs. Thomas will be at the St. Denis for several days.

THE MADISON SQUARE LIGHT COMPANY, operating the plant formerly controlled by the East River and Thomson-Houston companies, has mortgaged all its rights, privileges and franchises to the State Trust Company for $500,000 to pay off the indebtedness incurred by the acquisition of the East River plant.

MR. THOMAS AHEARN, president of the Ottawa Electric Company, Ottawa, Canada, was in the city last week and reports business as being very satisfactory in his city and vicinity. Mr. Ahearn's company is at present operating 550 arc lamps and 15,000 incandescents and doing a liberal portion of power business.

CHEAP LIGHT.—A bill is before the legislature which provides that city lighting contracts must be sold at auction and must secure to the city prices lower than any now prescribed by law. It further provides that the term of such lighting contracts shall not exceed 15 years, and that the successful bidder shall furnish private lights to the citizens at lower prices than the said bidder had previously been charging, and progressively lower for each year of the term. The bill is to take effect in the cities of New York, Brooklyn, and Buffalo.

W. J RICHARDSON, son of the late "Deacon" Richardson, and for many years secretary of the American Street Railway Association, died at the Presbyterian Hospital, New York, on April 26, after a surgical operation for hemorrhage of the bowels. Mr. Richardson was born at Albany, N. Y., Oct. 22, 1849, and in 1867 entered the street railway field as assistant to his father in the management of the Brooklyn & Jamaica Railway Company. Three years later he became superintendent of the Rockaway Beach Railway & Steamboat line, and in 1872 was made a director of the Atlantic Avenue Railway Company. Owing to his sympathy with the strikers in the late unpleasantness of the Atlantic Company with its employees, Mr. Richardson was dropped from the directorate of that company a few days before his death.

GEN. THOMAS T. ECKERT, president of the Western Union Telegraph Company, celebrated the seventieth anniversary of his birth on April 28, and the employees in the Western Union Building, at 195 Broadway, took advantage of the day to present a testimonial of their regard for Gen. Eckert personally, as well as their appreciation of his services as the president of the company. When he reached his office at the usual hour he was met by a delegation of more than thirty of the officers. They represented every department, and each one wore a bright flower on his coat. All personally congratulated the General on having passed his seventieth year in health and strength. Superintendent W. J Dealy, of the Commercial News Department, then presented Gen. Eckert with the employees' testimonial, consisting of a magnificent floral offering.

THE GENERAL ELECTRIC WINS ITS TAX SUIT.—Justice Leslie W. Russell, of the Supreme Court, handed down a decision last week relieving the General Electric Company from paying city taxes. The property of the Edison Electric Light Company was assessed originally at $140,000 and that of the Edison General Electric Company, which succeeded the former concern, was assessed at $15,000,000, but afterward reduced to $600,000. The General Electric property valuation was placed at $50,000,000 and later reduced to $8,040,800. The three companies (whose properties are held independently of each other, notwithstanding the control by the General Electric of all the interests) protested against paying taxes for 1894 on the ground that their offices and headquarters are in Schenectady County, where they are liable for taxes, if at any place. They took certiorari proceedings before the Supreme Court for the purpose of reviewing the action of the tax commissioners and the decision handed down by Judge Russell is the result. He holds that the taxing authorities of Schenectady County alone have the right to assess and tax the value of the personal property.

### NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, April 29, 1894.

FIVE CENT FARES to all parts of the city were adopted by the Bridgeport (Conn.) Traction Company on April 22.

BOSTON'S NEW POSTAL TROLLEY CARS are expected to be ready for service in a very few days. Second Assistant Postmaster Neilson expresses the opinion that the use of the cars will very greatly improve the local service.

THE QUESTION OF ELECTRICALLY DRIVING TEXTILE MACHINERY is being seriously investigated in New England. Mr. Sidney B. Paine, of Boston, read a paper on the subject last week at the annual meeting of the New England Cotton Manufacturers' Association, at Providence, R. I.

COMMISSIONER MURPHY has given the West End Company permission to remove its guard wires on all streets where no foreign wires cross the street or are liable to fall on the trolley wire. The commissioner has also perfected plans for the burying of the West End Company's feed wires as far as Adams street.

MR. HENRY F. KELLOGG, well and favorably known to the electrical fraternity, and who for some years past has been connected with the Whitney Electrical Instrument Company as its selling agent, is now identified with W. B. Southgate & Co., of Boston. Prominent among this firm's specialties are the Whitney instruments, so that Mr. Kellogg will continue to present to the electrical trade the acknowledged merits of these instruments, and at the same time a good line of other specialties.

THE WAGNER ELECTRIC COMPANY, of St. Louis, Mo., has opened an office at 620 Atlantic avenue, and will enter into active competition for the New England trade. Mr. Chas. E. Bibber will be in charge of the office. In our issue of April 20 it was stated that Messrs. Bibber & White had taken the agency at the above address of the Wagner Company and of the Columbia Incandescent Lamp Company, which was an error, Mr. Bibber representing both companies as general sales agent for the New England territory.

MESSRS. HOWARD C. FORBES AND GEORGE B. GLIDDEN have associated themselves under the firm names of Forbes & Glidden as electrical and chemical engineers, with offices and laboratory in the Hathaway Building, 620 Atlantic avenue, Boston. Mr. Forbes was for a long time connected with the firm of Stone & Webster, and has had considerable experience in designing and supervising electrical installations, and in the line of mechanical engineering as applied to the design and construction of apparatus and machinery to be used in carrying out chemical operations on a large scale. Mr. Glidden is possessed of excellent business qualifications and training. Both are young men of energy and ambition. The firm's announcement emphasizes the fact that the subjects of chemistry and electricity are so closely allied that the combination of the two has many important advantages.

## WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
936 Monadnock Building, Chicago,
April 27, 1895.

GODFREY LUTHY, of the Royal Electric Company, was one of the prominent Chicago visitors of the week.

MR. F. S. TERRY has returned to town after a long absence, and finds Sunbeam lamps in greater demand than ever.

THE CHICAGO EDISON COMPANY is fitting up its old station on Adams street as the general offices of the company. These will include ample space for the display and handling of supplies in which field of work this company expects to take an active part.

THE FARR TELEPHONE CONSTRUCTION & SUPPLY COMPANY has moved to its new store, 340 Dearborn street. This will hereafter be its office and salesroom. It has recently closed two very large contracts for telephones, and does not seem to have any complaint to make concerning dull business.

THE CHICAGO INSULATED WIRE COMPANY seems to be hustling right along. It has just arranged for commodious quarters at 153 Lake street, where it will carry a full line of the many kinds of wire and specialties which it manufactures. One of the recent orders which it has closed was for 200 miles of insulated copper wire.

## ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, April 17, 1895

INDUCTIVE TELEGRAPHY.—Last week the cable between the Isle of Mull and the Scotch mainland broke down, and messages were transmitted inductively on Mr. W. H. Preece's method across the intervening gap of 3½ miles. This is the first time on record that inductive telegraphy has been made use of in the ordinary course of business.

BOILERS AND ENGINE TENDERS.—A bill of a somewhat extraordinary nature is now before Parliament. It is entitled "The Engines and Boilers Act, 1895." It is proposed by this legislation to allow no one who has not got a first or second class certificate, to be granted by the Board of Trade after evidence of a certain number of years' service or after examination, to have charge of any but the smallest size of steam engine or boiler. It is not very evident on the face of the bill or after consideration what justification there is for this piece of grandmotherly legislation with its paraphernalia of examiners, examinations and certificates. It is surmised by some that the main object is to restrict the field from which men in charge of engines, boilers, etc., can be drawn in moments of emergency and in this way to strengthen the power of trade unionism.

ELECTRIC AND NAVAL BOILERS.—Although at first sight it may not appear so, there are several points of similarity between the working of electric power station boilers and boilers in the navy. Electrical engineers on this side of the Atlantic are, therefore, interested in a discussion which has been going on in *The Times* in regard to the use of water tube boilers on men-of-war. The recent action of the Admiralty in fitting two of our new cruisers, viz., H. M. S. "Powerful" and "Terrible," with Belleville boilers has given rise to considerable criticism, and it will be interesting to see how these two vessels, which are each of 25,000 hp, will carry themselves through the series of severe trials to which they will be subjected when their outfit is complete. The advocates of the water tube boiler in the navy put forward precisely the same arguments that the advocates of this boiler in electric power stations advanced, viz., the superiority in raising steam, increased durability and capacity to stand a very much higher rate of forcing.

ALTERNATE CURRENT ELECTRIC SUPPLY.—The Metropolitan Electric upply Company, although the largest concern of its kind in the United Kingdom, is by no means the most prosperous. Last year it only succeeded in paying a dividend of 2½ per cent. and this year it has only managed to scrape together sufficient net profit to give the shareholders a return of 3 per cent. for their money. The company covers a district in London having an area of 4¼ square miles, and at present has a lamp connection equivalent to 224,000 eight-candle lamps. During the past year the business of the company has been much hampered by an action brought against it in connection with its station at Manchester Square, and it has only been able to avert the complete closing of that generating centre by the substitution of Parsons steam turbines for Willans engines. It is no doubt due to this kind of thing and owing to the fact that the company possesses a most heterogeneous plant laid out in a by no means scientific fashion that this concern, notwithstanding the magnificent area it possesses and the absence of competition throughout the whole of its dominions, is unable, after more than four years' existence, to pay a better dividend than it does.

RAILWAY ELECTRIC LIGHTING.—A very practical paper has just been read before the Institution of Electrical Engineers by Mr. W. Langdon, of the Midland Railway Company, one of our most progressive railway lines. Mr. Langdon's paper is one of the most valuable testimonials the electric light has received for some time past, coming, as it does, from one who has no particular bias in favor of the new illuminant. In almost every case described by him, Mr. Langdon works out an enormous saving as being effected by the use of electric light, and when I add that much of the plant employed by the Midland Company is somewhat out of date, and employed, owing to circumstances beyond the control of the engineers, under somewhat disadvantageous conditions, it is not too much to anticipate that in more recent isolated railway plants, and in future ones, a still greater saving will be made. At Leicester the Midland Railway Company drive their dynamos by gas engines, using Dawson gas. Mr. Langdon is not enthusiastically in favor of this arrangement, but that may be on account of the short experience he has had. Although the Midland Railway Company some two years ago experimented largely with electrically lighted trains, Mr. Langdon was absolutely silent on that point, and this fact, in conjunction with the abandonment by the Midland Company of this system of lighting, may be considered as a conclusive sign that with the conditions which obtain on the Midland line, electric lighting of trains cannot be made a success. The discussion which arose on Mr. Langdon's paper was of an interesting and practical nature. There was a decided consensus of opinion in favor of the abandonment of high pressure series arc lighting for railway stations and goods yards purposes, and the substitution therefor of a three-wire system at a pressure of 220 or 440 volts with four or eight lamps in series across the outer wires One or two speakers, however, insisted, without giving too many reasons, that the future of railway lighting lay with alternating currents.

SODIUM IN ELECTRIC LIGHT CONDUITS.—The committee appointed by the Board of Trade to investigate the alleged deposit of sodium on the mains of the St. Pancras Vestry's electric supply has just published its report. The committee consisted of members appointed by the Royal Society, and by the Institution of Electrical Engineers, so that science and practice were equally represented. The committee is of opinion that the explosions which have occurred were caused by the firing of an explosive mixture of coal gas and air, by sparks caused by means of chemical incrustations found on the insulators. The sparks, the committee think, were caused by the imperfect conductivity of the deposit, or by moisture coming in contact with the metallic sodium or potassium, both of which metals have been found to exist within the incrustations. It is further the opinion of the committee that these metals were produced by the electrolytic decomposition of alkaline salts taken mainly from the soil and conveyed by moisture along the fibres of the wooden bearers on which the insulators rest toward the negative conductor. The chief engineer of the St. Pancras Vestry reported that these incrustations were first noticed some 18 months ago, and that some 60 or 70 per cent. of the insulators which were near enough to the manholes to be examined have been found to be attacked; incrustations in many cases forming again within 24 hours after removal. It is very evident that the main cause of the mischief, apart from the presence of alkaline substance in the soil, is the existence of the wooden bearers, since it has been found that very few of the insulators supported on iron brackets have been attacked. As there has been some suggestion that the insulators themselves have been actually decomposed by the passage of the current, I may say that the committee does not countenance this idea in any way. The glaze on the insulators has, it is true, been attacked in some cases, but this is, no doubt, a secondary action arising from the presence on the glaze of metallic sodium and potassium, and other powerful chemical reagents. Mr. Miller, of the Kensington Company, which uses a somewhat similar system of bare copper mains in culverts, stated before the committee that his company had scarcely suffered at all from the incrustation complaint; an immunity which he attributed to the fact that his company used very high quality double-shed insulators. Mr. Miller also drew attention to the extraordinary "affinity" which the negative main appears to have for moisture, and a most interesting scientific question is raised by this fact. The committee has contented itself with recommending that the wooden bearers in the St. Pancras mains should be immediately removed, and that better quality insulators of a better pattern should be immediately put in.

# General News.

## NEW INCORPORATIONS.

THE STANDARD TELEPHONE AND ELECTRIC COMPANY, capital stock $50,000, has been incorporated by S. S. Kilvington, E. W. Batchelder, H. C. Dodge, and G. L. Scott.

THE VANCE ELECTRIC COMPANY, New York, capital stock $10,000, has been formed to do general construction work. The promoters are A. S. Vance, Brooklyn; J. H. Cheever and C. C. Guiteau, New York.

NEW YORK, RED BANK & ASBURY PARK ELECTRIC RAILWAY, Red Bank, N. J., capital stock $500,000, has been incorporated by Ivan Prowattain, Philadelphia; Jos. W. Robinson, Red Bank, and others.

THE CRANFORD MUTUAL TELEPHONE COMPANY, Elizabeth, N. J., capital stock $10,000, has been incorporated by Wm. J. Lansley, Henry C.

Thornton, Joseph Watterman, Wilfred C. Allen, Geo. W. Littel and James Rodgers.

THE LAKE CHARLES ELECTRIC RAILWAY COMPANY, Lake Charles, La., capital stock $100,000, has been incorporated by Gustave A. Jahn, of New York, as president; R. H. Nason, Lake Charles, vice-president; William Stone, treasurer, and H. B. Milligan, secretary.

THE WAYNE & CONSHOHOCKEN STREET RAILWAY COMPANY, Chester, Pa., capital stock $80,000, has been formed to construct and operate a street railway The promoters are Francis Fenimore, St. Davids; Richard C. Johnson and Julius Bailey, of Wayne, Pa.

THE PACKARD ELECTRIC COMPANY, Ltd., recently of Montreal, was obliged on account of the growing demand for its well-known lamp to seek larger quarters, and consequently removed on April 25 to St. Catherines, Ont., where a new factory is being equipped, which will very materially increase the company's already large output.

THE MIDDLETOWN & BLOOMINGBURGH ELECTRIC RAILWAY COMPANY, Middletown, N. Y., capital stock $200,000, has been incorporated by W. B. Rockwell, Scranton, Pa., and Messrs. Wightman, LeBarr, Smith, McIntyre, Royce and Wiggins, of Middletown, for the purpose of operating a surface railway from Middletown to Bloomingburgh.

THE LAFAYETTE MACHINE, ELECTRIC LIGHT AND POWER COMPANY Denver, Col., capital stock $100.000, has been formed to conduct a machine shop for the manufacture and repair of electric fixtures, and to generate electricity for light, heat and power. The promoters are John S. Spencer, Frank D. Taggert and H. J. Mayham, of Denver, Col.

THE GREAT WESTERN ELECTRIC COMPANY, Des Moines, Ia., capital stock $500 000, has been formed to manufacture all kinds of electrical machinery, apparatus, appurtenances and supplies. Warren A Drake and L F. Dyrenforth, Riverside; Ralph H. Smith, Evanston; T. C. Sullivan, H. K. Gilman, Chicago, and C. E. Hunn, Des Moines, Ia., are interested parties.

THE WADSWORTH ELECTRIC RAILWAY COMPANY, Wadsworth, O., capital stock $10,000, has been formed to build railways operated by electricity or horse power, and to construct and operate telephone and telegraph lines furnish electricity for light, heat and power, etc. The promoters are F. C. McCauley, W. A. Ault, O. V. Dibble, R. F. Weaver, Frank Mills and W. S. Holloway.

THE ATLANTIC HIGHLANDS, RED BANK & LONG BRANCH ELECTRIC RAILWAY COMPANY, Red Bank, N. J., has been incorporated by D. S. Arnott, Silas Dutcher, W. H. Hazard, S. S. Whitehouse, Benj. Frick, Brooklyn, N. Y.; A. T. Allen, Hoboken, N. J.; Wm. T. Parker, Little Silver, N. J.; Wm. T. Corlies, Chas. B. Parsons, Arthur A. Patterson, Red Bank, and James Steen, Eatontown, N. J.

## TELEGRAPH AND TELEPHONE.

WADSWORTH, O.—Steps are being taken to establish a telephone system.

JACKSON, MISS.—The King-Price Telephone Company will extend its lines from this place to Crystal Springs and Brown's Wells.

BUTTE CITY, MONT.—W. McWhite and others have asked for a forty years' franchise to put in a new telephone system.

HANNIBAL, MO.—The new telephone line between this city and Spalding is rapidly approaching completion, and will probably be extended to Rensselaer and Monroe City.

CARTERSVILLE, GA.—The Cartersville Telephone Company has been incorporated by John W. Jones, H G. Leake and John W. Dodds to conduct an exchange; the capital stock is $5,000.

MERIDIAN, MISS.—The Mississippi Telephone Company is preparing to construct a 67-mile line to Philadelphia, Miss., by way of Hickory, Newton, Decatur and Union Station. The same company expects to connect New Orleans and Jackson, Miss., by telephone between now and autumn.

## ELECTRIC LIGHT AND POWER.

CASCADE, IA.—A $7,000 electric light plant is being established.

BARNARD, MO.—Steps are being taken looking to the establishment of an electric light plant.

MARION, VA.—The installation of an electric light plant to be operated by water power is being investigated.

NEW ORLEANS, LA.—An electric plant is to be installed by the St. Charles Hotel Company in its new building.

GLEN COVE, L. I., N. Y.—The Franklin Illuminating Company will establish an electric lighting system at this place.

AUBURN, N. Y.—The erection of a municipal electric plant is contemplated. Address Mayor Lewis for further particulars.

ROPER CITY, N. C.—The erection of a new electric lighting plant is contemplated. Address the clerk of the Council for particulars.

DECATUR, ILL.—It is reported that the Municipal Electric Lighting Company has decided to enlarge their plant in the near future.

NEWTOWN, N. Y.—The installation of an electric lighting system in this town is contemplated. Address the town clerk for particulars.

NEW ORLEANS, LA.—Maurice Kaufman, 407 Kamp street, is in the market for an electric lighting plant with a capacity of 500 16-cp lights.

LANCASTER, WIS.—A franchise has been granted Edward Pollock for the construction and operation of an electric light and power plant.

MONTPELIER, VT.—The City Council has contracted for lighting the streets for the coming year on a basis of 52 arc lights for 300 nights for $4,000.

ENTERPRISE, MISS.—L. B. Bradley, of Enterprise, and S H. Gelheman, of Springfield, Ill., have obtained a franchise for an electric light plant.

SOUTH MILWAUKEE, WIS.—The South Milwaukee Light and Power Company has increased its capital stock to $20,000. Mr. F. B. Williams is manager.

WEST CHESTER, PA.—The erection of a new electric light plant at this place is contemplated. Address the clerk of the Council for further particulars.

BARDSTOWN, KY.—The construction of an electric lighting plant at this place is contemplated. O. Arnold is interested and can be addressed for particulars.

PHELPS, N. Y.—It is reported that an electric lighting system is to be established here in the near future. The clerk of the Council can furnish detailed information.

MILAN, MO.—The erection of an electric lighting plant at this place is contemplated. A franchise has been applied for, and the clerk of the Council can be addressed.

ELLICOTT CITY, MD.—The Ellicott City Electric Light and Power Company's plant has been sold to Wm. P. Pierpoint for $1,000. Mr. Pierpoint held a mortgage on the property.

HOLYOKE, MASS.—Sealed proposals are being received for the furnishing of electric lighting for the city. R. S. Burns, of the City Council, can be addressed for particulars.

NEW YORK CITY.—A five-story casino and roof garden is to be built on 101st street and Columbus avenue by George W. Eggers, and will be provided with electric light equipment.

SOUTH HAVEN, MICH.—The town authorities will issue $10,000 worth of bonds for the erection of an electric lighting plant. Address the clerk of the Council for further details.

BIRMINGHAM, ALA.—The Consolidated Electric Light Company will build a new plant to cost $200,000. The machinery will include five engines of 2,500 hp each. The contract has been let.

BENTON HARBOR, MICH.—A franchise has been applied for by Peter English to establish an electric lighting plant at this place. The clerk of the City Council can be addressed for detailed information.

HACKETTSTOWN, N. J.—Bids will be received until May 6 for the lighting of the streets of this town with electricity for the coming year. Wallace Taylor, W. C. Merrell and J. N. Niper are the committee in charge.

THE HOBART & WESTERN ELECTRIC RAILWAY COMPANY, Hobart, Ind., capital stock $50,000, has been formed. The promoters are Alfred Morrison, Andrew J. Smith, George Stoker and Seward Lightner.

NEW YORK CITY.—Electric lighting is to be introduced in the nine-story fireproof office building, which is to be built for the Hournay estate, 43 Lispenard street, after plans prepared by Cady, Berg & See, 31 East 17th street.

NORTHFIELD, VT.—The contract for the new electric plant calls for the completion of the day power equipment May 1, and the starting of the street lights by May 15 The cost of the complete plant will be $7,500. Water power will be used.

NEW BRIGHTON, N. Y.—Sealed proposals will be received for the erection and operation of an electric lighting system for lighting the village streets for a term of one year. Joseph F. O'Grady, village clerk, can be addressed for further information.

## THE ELECTRIC RAILWAY.

ATLANTA, GA.—A franchise has been asked for by Richard D. Fisher and others to build an electric railway.

READING, PA.—Work will be soon commenced on the construction of the Reading & Womelsdorf Electric Railway.

ENTERPRISE, MISS.—The construction of an electric railway is contemplated by L. D. Bradley, of Springfield, Ill.

COLUMBIA, PA.—Surveys have been commenced by Civil Engineer Edward M. Smith for the proposed electric railway to Mt. Joy.

ATLANTA, GA.—A franchise has been applied for by R. D. Fisher, to construct an electric railway on certain streets of this city.

SANFORD, FLA.—The construction of an electric railway from this place to Orlando is contemplated by J. M. Saunders and A. Williams.

LOWER PROVIDENCE, PA.—The Norristown & Perkiomen Railway Company has applied for a franchise to construct a trolley line through this town.

MEMPHIS, TENN.—Messrs. J. R. Goodwin, E. S. Proudfit and J. W. Allison have applied for a franchise to build a trolley road in this city.

READING, PA.—The Reading & Southwestern Railway Company has applied for a franchise for right of way on certain streets of this city.

MEDIA, PA.—The Delaware County & Philadelphia Railway Company has petitioned for a franchise to extend its line on Washington street.

TROY, N. Y.—Permission has been granted the Troy City Railway Company to convert its line into an electric road from Green Island to Cohoes.

ALEXANDRIA, VA.—The Alexandria & Mt. Vernon Railway Company has applied for permission to begin work on the construction of their line.

REMINGTON, PA.—It is reported that the Peoples' Electric Street Railway Company, of Pittsburgh, will extend its line from Freedom to this place.

BARRINGTON, R. I.—A charter has been applied for by the Barrington & Warren Railway Company, to construct a line between the points named.

PEKIN, ILL.—The construction of an electric railway from this city to Metamora is contemplated. Daniel Birket is interested, and can be addressed.

GRAFTON, W. VA.—Work will be commenced in the near future on the construction of an electric street railway in this town through to Huntytown.

CARTHAGE, N. Y.—The construction of a railway from this place to Copenhagen, a distance of eight miles, is projected. The estimated cost is $100,000.

KINGSBORO, N. Y.—The building of an electric railway from this place to Mountain Lake, a distance of four miles, is projected. Surveys have been made.

SYRACUSE, N. Y.—It is reported that a trolley line is to be built between this city and Liverpool. Address the clerk of the Council of the latter place for particulars.

FLUSHING, L. I., N. Y.—The Newtown Railway Company has applied for a franchise to construct its line over Flushing Bridge, and through certain streets of this town.

GENEVA, N. Y.—The Electric Railway Company has applied for permission to construct its road on West Castle street. President Craig can be addressed for particulars.

BAY SHORE, L. I., N. Y.—It is proposed to build a line from Brentwood to Babylon via Bay Shore and a franchise has been applied for. W. W. Hulse can furnish particulars.

HACKENSACK, N. J.—The Bergen Turnpike Company has applied for right of way for its proposed trolley line through this place. James J. Romeyn can be addressed for particulars.

ATTLEBORO, MASS.—The Interstate Consolidated Street Railway Company has been organized. N. J. Perry is president, and E. R. Price, H. R. Baker and others are among the directors.

ROCHESTER, N. Y.—The Rochester Railway Company has applied for a franchise to extend its line. The general manager of the company can be addressed for detailed information.

YORKVILLE, PA.—A meeting was held recently to consider a petition for the extension of the electric railway through this village on Market street. President R. H. Koch can be addressed.

WASHINGTON, D. C.—The Washington, Alexandria & Mt. Vernon Electric Railway Company has petitioned to complete its line in this city. Ex-Mayor Strauss, of Alexandria, is interested.

TOLEDO, O.—It is reported that a company is being organized for the purpose of constructing an electric road from this city to Sylvania. Address the clerk of the Council for information.

LONGWOOD, FLA.—Address E. W. Hencke concerning an electric railway to be established, requiring three horse-power plants, two of 100 hp each, and one of 300 hp, and costing with road $400,000.

PORT HURON, MICH.—It is reported that an electric railway is to be built from this place to Lexington in the near future. Edgar H. Brennan, of Toledo, is interested, and can furnish detailed information.

## PERSONAL NOTES.

MR. CHARLES L. TOLLES, of the Jewell Belting Company, of Hartford, Conn., and Miss Annie Louise Roberts were married at the home of the bride's parents in Hartford, April 24.

MR. L. HORTON, JR., has been appointed superintendent of the Philadelphia, Reading & Pottsville Telegraph Company, vice Mr. E. R. Adams, deceased, with headquarters at Reading, Pa.

## MISCELLANEOUS NOTES.

THE GETTYSBURG BATTLEFIELD.—In the litigation over the taking of land from the Gettysburg Electric Railway Company by the government for the purpose of preserving the battlefield, a decision in favor of the railway company has been handed down by Judge Dallas in the United States Circuit Court. The case will probably be carried to the Supreme Court.

AT THE NEW YORK ELECTRICAL SOCIETY'S April meeting, fixed for the 25th inst., Mr. T. L. Willson was to have delivered a lecture on acetylene gas. At the last moment Mr. Willson had to leave for the West, and Mr. Edward Durant filled the gap by repeating before the Society on the 24th inst. his lecture given on the 16th before the Brooklyn Institute on "The Manufacture in the Electric Furnace of Diamonds, Rubies, Aluminum and Acetylene Gas."

THE ELECTRICAL SOCIETY OF CORNELL UNIVERSITY held a meeting on April 22, at which Prof. H. J. Ryan presented an admirable paper on the "Alternating Current Motor." By the aid of lantern slides he showed clearly the conditions necessary for the efficient working of synchronous motors, the ordinary induction motor, and the monocyclic motor. Curves were exhibited, drawn from data obtained by experiments in the Cornell laboratory, showing the effect of a change in resistance upon the relations between speed and torque. The paper will be published in full in the *Proceedings* of the Society, which will appear about the middle of May.

# Trade and Industrial Notes.

THE AMERICAN ELECTRIC MANUFACTURING COMPANY has removed its New York office to 39 Cortlandt street.

E. W. WILSON & COMPANY, bankers and brokers, New York, have removed their offices from 96 Broadway to 40-42 Wall street.

THE IMPERIAL ELECTRIC LAMP COMPANY, now at 253 Broadway, New York, will remove its offices and factory on May 1 to 75-79 Fulton street.

ELLIOTT BROTHERS, London, have appointed Jas. G. Biddle, of 525 Drexel Building, Philadelphia, their sole agent in the United States and Canada.

THOMAS H. FOOTE, consulting electrical engineer, has removed his office from 215 West 125th street to the Presbyterian Building, corner Fifth avenue and 20th street, New York.

THE PROCTOR-RAYMOND ELECTRIC COMPANY, Syracuse, N. Y., has gone into receiver's hands. The court appointed E. A. Marsh, of Keeler, Salisbury, Marsh & Ward, to the receivership.

THE H. E. SMITH ELECTRICAL COMPANY, Batavia, N. Y., is making a success of its telephone exchange at Batavia, over 50 subscribers being already enrolled. The company, besides operating the local exchange, is engaged in a general electrical contracting and supply business.

THE C. W. HUNT COMPANY, 45 Broadway, New York, is meeting with flattering success in its line of work. Among other recent installations is a system of overhead trolleys put in the factory of the Ahrens & Ott Manufacturing Co., at Louisville, Ky., for handling the various materials.

THE MIAMISBURG ELECTRIC COMPANY, Miamisburg, Ohio, reports increased sales in its battery department, a large number of Burnley "Cartridge" batteries having been shipped during April for telephone use exclusively. This company expects to put on the market soon a pair of batteries especially adapted for carbon transmitter service.

THE INTERIOR CONDUIT & INSULATION COMPANY, of 527 West Thirty-fourth street, New York, is sending out catalogue and price list No. 24 descriptive of the 1895 Lundell fan motors for direct and alternating current circuits. The line comprises desk, bracket and suspended fans of the "windmill" or "propeller" type, as well as the two-blade type of ceiling fans.

THE JEFFREY MANUFACTURING COMPANY, of Columbus, O., has issued an exceedingly handsome catalogue describing its line of coal mining machinery and equipment, which includes electric chain coal cutters, cutter-bar mining machines, cutter-bar air power mining machines, electric drills, pumps, locomotives, hoists, conveyers, etc., etc. The book is printed on heavy plate paper, and provided with an attractive embossed cover.

EDWARD F. KEATING, 446-454 Water street New York, reports marked success in placing his new Brownley injector, for which he makes strong claims. The injector is a double-tube machine, has no valves to get out of order, and can be used under both high and low pressures from 15 to 350 pounds. The strongest claim made, however, is that this injector will work hot water with perfect satisfaction. Mr. Keating is distributing copies of a circular containing some very favorable testimonials.

THE ELECTRIC HEAT ALARM COMPANY, of 145 High street, Boston, has contracted, through its agent at St. Paul, to equip the Ryan Hotel, the largest in the city, with its system of automatic fire alarms. This installation, when completed, will be one of the best in the country. The company has just finished a very nice office outfit, comprising factory, hotel, journal bearing and marine systems, for the Continental Commerce Company, 44 Pine street, New York, and 70 Oxford street, London, Eng.

THE NORTHERN PACIFIC RAILWAY COMPANY, in an elaborately gotten up book entitled "Sketches of Wonderland," describes at length the country through which its lines run. The book is replete with well-executed engravings illustrating the principal features of interest, among which may be mentioned Detroit Lake, Pyramid Park, the Yakima Valley, Yellowstone River and Park, Mount Rainier and the cities of Spokane, Tacoma and Seattle. The book is interesting from cover to cover, and as a specimen of advertising, taste, and skill is exceedingly fine.

THE FOREST CITY ELECTRIC WORKS, of Cleveland, Ohio, manufacturers of the well-known roll drop commutator segments for dynamos and motors, has established an office in New York at 126 Liberty street, which will have general oversight of the eastern territory. Mr. John C. Dolph, formerly connected with the Short Electric Railway Company, and for the past two years eastern representative of the Eureka Tempered Copper Company, has been appointed manager of the above district. It is the policy of the company to push vigorously the sale of its products in eastern territory. A large stock of standard street railway and lighting segments will be carried in the New York store-room.

THE HEINE SAFETY BOILER COMPANY, St. Louis, has issued a statement in regard to a recent contract for twelve Heine boilers, aggregating 4,500 hp for the Edison Illuminating Company, St. Louis. Its competitors having claimed that the allowance of heating surface per horse-power in the Heine boilers was insufficient, the following guarantees, with forfeit and bonus, were made to protect the Edison Illuminating Company on the point. The boilers sold them, like all Heine boilers, have from 25 to 30 per cent. less heating surface than competitors claim as requisite for best economy and proper forcing margin in their boilers of equal horse-power rating. The guarantee (with straight grates and plain setting) was an evaporation of 8 lbs. water (from and at 212 degrees F.) per pound Illinois coal having a heat value of 11,500 B. T. U. per pound, and an evaporation of 7 lbs. water per hour per sq. ft. H. S. equal to 64.2 per cent. of above rating), with less than 1 per cent entrainment of water. The result of tests made by Wm. H. Bryan, M. E., show that a run at 26 per cent above the rating gave 8,335 lbs. water per pound Illinois coal of 11,481 B. T. U. (equal to 70.13 per cent. efficiency), and a capacity test gave 7,258 lbs. water per hour per sq. ft. H. S. (equal to 70.8 per cent. above rating), with 84-100ths of 1 per cent. entrainment.

WARREN WEBSTER & CO., Camden, N. J., specialists in examining steam plants where increased economy in fuel is desired by utilizing waste exhaust steam, report that there is considerable activity in their business, which they claim is due to the better appreciation of their manufactures. Among the recent orders for the Webster "vacuum" feed-water heater and purifier are the following: Estate of John Nesmith, Lowell, Mass., 100-hp; New Orleans Railway and Mill Supply Company, New Orleans, La., 200-hp; The Proctor & Gamble Company, Ivorydale, O., 3,000-hp; Pennsylvania Tin Plate Company, New Kensington, Pa., two 500-hp; Norwich Printing, Dyeing and Finishing Company, Norwich, Conn., 3,000-hp; Water and Light Company, Harrisburg, Pa., 500-hp; J. Horne & Co., Pittsburgh, Pa., 250-hp; A. Hubbard & Co., Norwich, Conn., 300-hp; W. F. Slade & Co., Pascoag, R. I., 500 hp; Nashau River Paper Company, East Pepperill, Mass., 600-hp; Standard Steel Works, Burnham, Pa. (duplicate), 400-hp; Aultman & Taylor Machinery Company, Mansfield, O., 500-hp; F. S. Field & Co., Boonton, N. J., 300-hp; Pulaski Iron Company, Pulaski City, Pa., 300-hp; Russell & Co., Massillon, O., 400-hp; Arbegast & Bastain, Allentown, Pa., 150-hp; Crescent Steel Works, Pittsburgh, Pa., 750-hp; Moro Phillips Chemical Company, Camden, N. J., 450-hp; Crane & Waters, Millbury, Mass., 400-hp. In a number of the above contracts standard makes of feed water heaters were displaced. Numerous orders are also reported for the Webster separators and Williams vacuum system of steam heating.

# Business Notice

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

# Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED APRIL 24, 1895.

[In charge of Wm A. Rosenbaum, 177 Times Building, New York.]

537,855. ELECTRIC APPLIANCE FOR ELEVATORS; J. H. Roberts, Grand Rapids, Mich. App. filed Oct. 6, 1894. An appliance for elevators having independently mounted switches with conductors, contacts and suitable means for switching the main line and auxiliary conductors, combined with a liquid chamber having a piston at each end, and brake mechanism connected with one of said pistons, the other being exposed to the action of the descending elevator.

537,856. ELECTRICAL APPLIANCE FOR ELEVATORS; J. H. Roberts, Grand Rapids, Mich. App. filed Feb. 23, 1895. Substantially the same as the above.

No. 537,876.—Rheostat.

537,857. ELECTRIC MOTOR CAR; William Robinson, Boston, Mass. App. filed Jan. 16, 1890. The combination, with the car axles, of a motor having one end directly supported by one of the said axles and the other end flexibly supported by an independent bar, the said bar being in turn supported partly by the motor journal boxes and partly, directly or indirectly, by another car axle, independently of the truck frame and of the ordinary axle boxes.

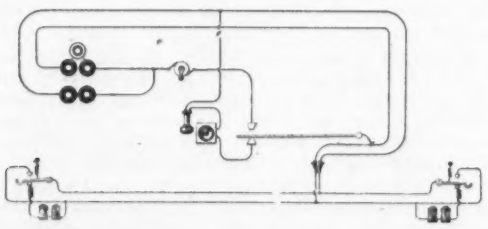
537,860. ELECTRIC GUEST CALL; F. O. Smith, La Crosse, Wis. App. filed June 2, 1894. The combination of a clock, an electric bell and a battery having its poles electrically connected with the clock, a series of insulated wires with exposed ends projecting to form a series of contact points around the clock mechanism, a circuit closing finger attached to the hour arbor of the clock adapted to form electrical contact with the said contact points, and a keyboard and removable room indicating checks adapted to be hung upon said keys.

537,876. RHEOSTAT; G. H. Whittingham, Baltimore, Md. App filed Dec. 11, 1893. The combination of a heat radiating casing, a resistance wire within the casing, and loose sand packed within the casing and separating the resistance wire from the casing.

537,907. ROSETTE OR CEILING CUT-OUT; E. A. Snow, Syracuse, N. Y. App. filed Sept. 21, 1894. The combination of oppositely arranged fastening and circuit-connecting members, each being provided with an arm extending outwardly, and a second arm having one extremity extending laterally from the first arm, and provided with a contact face; each arm having its outer extremity provided with an engaging shoulder extending from the face, for engaging another face.

537,920. COUPLING FOR ELECTRICAL CONNECTIONS; J. M. Faulkner, Philadelphia, Pa. App. filed Aug. 9, 1894. A coupling made in longitudinal sections internally formed to rigidly grip the wire, and having fastening means, one of the sections having an internal depression containing mercury engaging the conductors.

537,932. METHOD OF AN APPARATUS FOR PROTECTING ELECTRIC CIRCUITS; J. M. Oram, Dallas, Tex. App. filed Jan. 15, 1895. The combination, in an automatic variable signal transmitter, of a movable carrier, a shifting device controlling the movements of the carrier, a circuit closing device carried upon the carrier, and a series of points forming a plan for actuating the circuit closer, with means for arbitrarily changing the plan.



No. 537,967.—Telephone System.

537,967. TELEPHONE SYSTEM; Wm. Coonan, Jersey City, N. J. App. filed Aug. 4, 1892. The combination of a subscriber's line, an artificial resistance, and a bell magnet therein at the subscriber's station, a switch arranged to cut the resistance out and leave the line closed, a central office testing apparatus, consisting of two electro-magnets of different resistances connected in parallel, an operator's switching apparatus, and means whereby the subscriber's line may be connected in series with one of the magnets.

537,989. STORAGE BATTERY; M. Moskowitz, Newark, N. J. App. filed May 7, 1894. A battery having a single cell, bearings in the cell, a bearing bar, and elements on the bar; the elements being wound spirally to permit free action of expansion and contraction, and having their free ends rigidly connected with the cell.

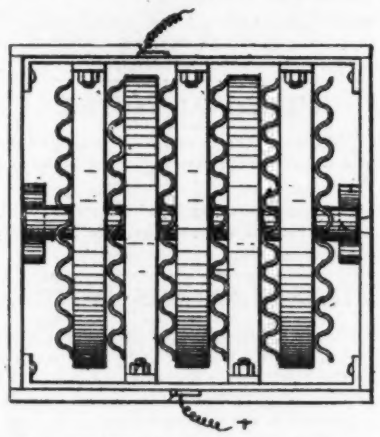
537,994. CONTROLLING MECHANISM FOR ELECTRIC MOTORS; C. H. Richardson, Philadelphia, Pa. App. filed June 9, 1894. The combination of a motor, conductors connecting the armature of the motor with the supply circuit, a speed regulating resistance in the supply circuit, a supplementary resistance and switch mechanism therefor, by the adjustment of which regulating resistance the armature is short-circuited and the supplementary resistance is thrown in to prevent an overflow of current. By a reverse movement of the supplementary resistance switch the opposite result is obtained.

538,005. ELECTRIC RAILWAY; C. C. G. Wolpers, Brooklyn, N. Y. App. filed Oct. 2, 1894. A trolley consisting of a vertical arm having a receiving groove and bores connecting with the respective ends of said groove, insulated plugs, a covering plate removably attached to the arm, a wire-receiving arm removably secured to the lower end of the vertical arm, a contact wheel journaled on the horizontal arm, and an insulating spool and a contact bushing interposed between the wheel and the arm.

538,020. INSULATED CONDUCTOR; W. M. Habirshaw, New York, N. Y. App. filed Oct. 16, 1894. The combination of a conducting core with an insulating coating or covering composed of continuous layers of soft vulcanized rubber and cut-sheet alternately applied.

538,023. ELECTRIC ARC LAMP; F. M. Lewis, London, Eng. App. filed Oct. 12, 1894. The combination of a single solenoid and plunger, a rocking beam, and a differential train for the purpose of enabling the striking and feeding movements to take place independently of each other.

538,024. ELECTRIC BRAKE; E. D. Lewis, Savonia, N. Y. App. filed Dec. 7, 1894. The combination of a brake, a spring for normally holding the brake set, means for varying the tension of the spring, an electro-magnet disposed to normally act in opposition to the spring to release the brakes and hold them out of action until the circuit is interrupted, and means for varying or changing the relative position of the electro-magnet.



No. 537,989.—Storage Battery.

538,083. SEPARABLE TERMINAL FOR CONDUCTORS. D. N. Osyor, Columbus, Ohio. App. filed Nov. 28, 1893. The combination of stationary terminals insulated from each other, and having recesses, a portable conductor section having insulated terminals, with two pairs of contacts in opposition to each other, one of the said pairs of terminals being detachably fitted to the other and having devices adapted to bear against the other during the rocking movement.

538,090. ELECTRIC CUT-OUT; H. A. Wagner and F. Schwedtmann, St. Louis, Mo. App. filed Jan. 5, 1895. The combination of an outer shell, a removable core fitting closely therein, a helix around such core, a fusible wire in such helix a contact ring around the core near its upper end, a contact plug in the lower end of the core, and a contact ring and plug of the shell adapted to make contact with those of the core when it is in place.

538,097. COMMUTATOR BRUSH; L. Boudreaux, Paris, France. App. filed Oct. 28, 1892. A brush formed of superposed folds of metallic sheet foil compressed into a compact body.

538,104. ELECTRIC MOTOR FOR RAILWAY CARS; C. E. Emery, Brooklyn, N. Y. App. filed April 19, 1894. A motor adapted for use under a car by arranging the field magnets horizontally and the armature axle at the same elevation as the car axle, with an intermediate idle gear for transmitting motion from a pinion on the armature shaft to a spur gear on the car axle, the three gears being supported by suitable framing, journals and bearings in a continuously fixed relation one to the other.

538,127. ELECTRIC DOOR OPENER; J. Schneider, Long Island City, N. Y. App. filed May 7, 1894. The combination of a casing, a magnet, an armature lever, a rock-lever pivoted in the casing and adapted when moved in one direction to be held stationary by the armature lever, and when moved in the other direction to be out of position to be engaged by the armature lever, and a catch mounted to swing and adapted by a bolt on the door.

538,186. WORKING OF RAILWAY POINTS AND SIGNALS BY ELECTRICITY; I. A. Timmis, London, Eng. App. filed June 9, 1894. The combination of points provided with a locking bar, a locking bolt, two electric motors for operating the points, the home branch and distant signals, each provided with an electro-magnet for operating it; connections placing the magnets of the branch or the main line signals in circuit, and interlocking switches having electrical connections to send current to the motors and to the magnets of the home and distant signals in rotation.

538,224. AUTOMATIC CUT-OUT SYSTEM; L. L. Borradaile, Philadelphia, Pa. App. filed Feb. 5, 1895. An automatic cut-out comprising a hollow trolley wire supported upon a bracket having a passage in communication with the trolley wire, and pneumatic contact devices on the bracket.